Missouri Department of NATURAL RESOURCES dnr.mo.gov
Michael L. Parson, Governor Carol S. Comer, Director

March 21, 2019

Ms. Jamie Bernard-Drakey
U.S. EPA, Region VII
Superfund Division
11201 Renner Blvd
Lenexa, KS 66219

Dear Ms. Bernard-Drakey:

The Missouri Department of Natural Resources' (Department), Environmental Remediation Program's (ERP) Superfund Site Assessment Unit (SAU) has completed a Site Reassessment for the Camdenton Sludge Disposal Area (MOSFN070352), under the Superfund Combined Cooperative Agreement. As per the grant requirements, enclosed is an electronic copy of the report. A brief summary of the findings is provided below.

Site Name	**Report Type**	**Recommendation**
Camdenton Sludge Disposal Area	Site Reassessment	No Further Action Needed

Site Reassessment

The Camdenton Sludge Disposal Area was originally investigated by the department in 1999 PA/SI as a site where sludge from a mixed residential and industrial waste lagoon (City Lagoon #3 or "Hulett Lagoon" [MOSFN0703530]) were disposed of after its closure in 1989. The site is located in a field on the south side of the City of Camdenton Municipal airport approximately three miles south of the city of Camdenton. The contaminants of concern are VOCs (including TCE) and metals (primarily chromium). The Department's 1999 PA/SI conducted groundwater and soil/waste sampling and concluded that while there were some metals present in the wastes at concentrations above background levels, they were below levels that would require removal action. No TCE was detected in the Department's samples of groundwater from local drinking water wells during the 1999 PA/SI.

In 2017 concerns regarding TCE contamination in the Camdenton area prompted the Department to initiate a Site Reassessment of the Camdenton Sludge Disposal Area site. The Department also examined claims from a Camdenton resident alleging that waste from City Lagoon # 3 had been disposed of at additional properties in the Camdenton area. The Department interviewed the landowners involved and the City of Camdenton Utility Operators and it was determined that no additional properties had received waste from City Lagoon #3 as they had accepted waste from other city lagoons several years after the City Lagoon #3 had been closed.

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The Department conducted environmental sampling for the SR investigation on October 2 and 19, 2017 and February 13, 2018. Groundwater was sampled from 11 private wells and one public well (currently a backup well not in regular use) in the vicinity of the Camdenton Sludge Disposal area. Groundwater from two private wells over four miles from the site were also sampled to establish background concentrations.

TCE was not detected in any of the groundwater samples collected during the Site Reassessment. Lead was detected in groundwater at concentrations above the 15 µg/L Action Level in one of the private wells within a half mile of the site and in one of the background wells. The private well near the site with lead detected over the Action Level was resampled from an indoor faucet and it was determined that the water softener in the home was functioning as a filter as the samples collected indoors were non-detect for lead. Lead was not detected in the sludge samples at high concentrations during the 1999 PA/SI investigation and is not considered a site related contaminant. The background well with lead detected in groundwater samples over the Action Level was referred to the USEPA Removal Program as part of the Central Mining District Lead- Camden County (MON000705679).

Chromium was detected at 4.41µg/L in the public Camden County PWSD#2 Well #1 groundwater sample, which is below the MCL of 100 µg/L. Following the detection of chromium the public well was resampled for hexavalent chromium analysis and was found to have 0.31 µg/L Cr^{+6} which is below the Removal Management Level for Cr^{+6}. Chromium was not detected in any of the other groundwater samples collected during the Site Reassessment. No further Superfund response action is required at this time.

If you have any questions or concerns, please do not hesitate to contact me by mail at the Department of Natural Resources, Environmental Remediation Program, P.O. Box 176, Jefferson City, MO 65102-0176, by phone at (573) 751-1388 or 1-800-361-4827, or by e-mail at martin.kator@dnr.mo.gov.

Sincerely,

ENVIRONMENTAL REMEDIATION PROGRAM

Martin Kator,
Site Assessment Unit Chief
Superfund Section

MK:rc

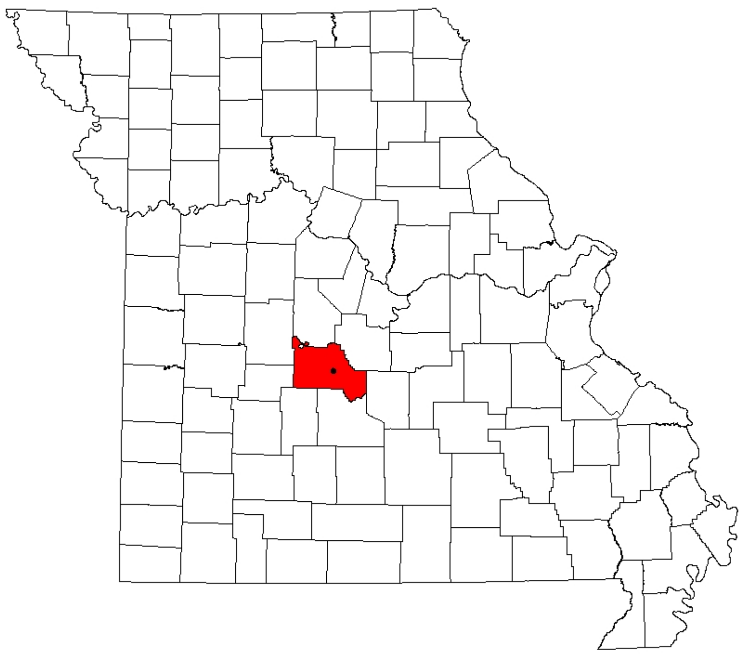
c: Ms. Cindy Davies, Southwest Regional Office
Ms. Tanya Turner, Southwest Regional Office

Enclosures

SITE REASSESSMENT REPORT

Camdenton Sludge Disposal Area Site
Camden County, Missouri

March 11, 2019



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

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DATE: March 11, 2019
PREPARED BY: Keith Brown, Missouri Department of Natural Resources
SITE: Camdenton Sludge Disposal Area, Camden County
C.A. NUMBER: V99738108

EPA ID. NUMBER: MOSFN0703532

1.0 INTRODUCTION

Under the authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Missouri Department of Natural Resources (Department), through a cooperative agreement with the U.S. Environmental Protection Agency (USEPA), conducted a Site Reassessment (SR) at the Camdenton Sludge Disposal Area Site in Camden County, Missouri.

The Camdenton Sludge Disposal Area site is a 40 acre portion of the City of Camdenton Memorial-Lake Regional Airport (KOZS) where over 2,000 cubic feet of sludge wastes from a residential/industrial wastewater treatment lagoon were disposed of in 1989. The sludge originated from the City Lagoon #3 (formerly known as Hulett Lagoon) (EPA ID No MOSFN0703530) which operated from 1961 to 1989 and accepted municipal sewage and industrial waste from a manufacturing facility located at 221 Sunset Drive (Modine Manufacturing Co., EPA ID No. MOD062439351) (MDNR, 1999, Wilder, 1999c). The industrial waste contained trichloroethylene (TCE) and dissolved metals. The City Lagoon #3 was closed in 1989 when the lagoon was dewatered and the sludge was removed for transport and disposal. The Department's Water Protection Program permitted the disposal of the sludge at the Camdenton Memorial Airport after testing to confirm that metals concentrations did not exceed USEPA regulatory thresholds (Friese, 1988, Friese, 1989).

The Department completed a Combined Preliminary Assessment/Site Inspection (PA/SI) investigation for the Camdenton Sludge Disposal Area site in 1999 and concluded that no further CERCLA assessment was warranted at that time. Soil borings conducted by the Department encountered the sludge on site and testing revealed that it did not contain TCE. Private and public wells within one quarter mile were sampled for volatile organic compounds (VOC) and metals content during the PA/SI and no contaminants above health based levels of concern were detected.

The current Site Reassessment investigation was initiated in response to citizen concerns that area groundwater was impacted by the sludge disposal area, and allegations that additional locations besides airport had been used as sludge disposal sites (Burns, 2017). The Department initiated the Site Reassessment investigation on June 30, 2017 to examine whether the site poses a threat to human health through the groundwater/drinking water exposure pathway.

The purpose of this investigation was to collect sufficient information concerning conditions at the site to assess the threat posed to human health and the environment through the groundwater/drinking water pathway. The scope of the investigation included a review of available file information, and collection and analysis of groundwater sampling data from public and private wells surrounding the site. Investigation activities included sampling events on October 2, 2017, October 19, 2017, and February 13, 2018.

2.0 SITE DESCRIPTION

2.1 Location

The Camdenton Sludge Disposal Area site is located on County Road 5-120 in the southeast portion of the Camdenton Memorial Airport property. The site is located on city property three miles southeast of Camdenton city limits (Figure 1). The geographic coordinates of the site as measured from the field where the sludge was applied are 37.968892 latitude and -92.687353 longitude. The sludge disposal area was identified at the southeast side of the airport; however in 2002 a portion of the original disposal area was covered by pavement during an expansion of the runway (Mroczka, 2016, Coleman, 2017). The site is approximately four miles from three other sites in Camdenton with known soil and/or groundwater (TCE) contamination; City Lagoon #3 (where the sludge originated), 221 Sunset Drive former manufacturing facility (formerly operated by Dawson Metal Products, Sundstrand and Modine Manufacturing Co.), Dawson Metal Products Camdenton Facility #2 (Figure 2).

Directions to the site are as follows: From Jefferson City take U.S. Highway 54 West for 56 miles (traveling west and south) from the intersection of U.S. Highway 54 and State Route 5 in Camdenton by taking State Route 5 southeast for 4.4 miles to County Road 5-120; take a left onto CR 5-120 (portions of which are unimproved road) and travel east. The disposal area is 0.3 of a mile down the road on the north side.

Camden County has a temperate climate with cold winters and hot summers. The Camdenton area receives an average of 42.32 inches of precipitation annually, and an average of 19 inches of snowfall annually (USDC, 1961. The maximum expected two-year, 24-hour rainfall is approximately 3.5 inches (USDC, 1968). The average daily temperature during the summer months is 77° F, and the average winter temperature is 35° F (USDA, 1994). The average wind speed and direction is approximately 10 miles per hour from the south (USDC, 1968).

2.1.2 Site Description

The site is located south of Camdenton, a community of 3,718 residents (USCB, 2017), in a semi-rural portion of Camden County in central Missouri. The site consists of an open field adjacent to the landing strip of the Camdenton Municipal Airport where sludge from the City Lagoon #3 was applied in 1989 (Figure 1). A portion of the original site has been covered up during extension of the airport runway. The airport property can be accessed through 20 Airport Road and other than this entrance, the site is completely fenced to prevent trespassers and livestock from accessing the runway.

At the time of disposal, 42.4 acres were set aside for the sludge application; however, the actual area of sludge disposal was reportedly less than 42 acres (Wilder, 1999a). The sludge disposal area consisted of a designated circular stockpiling area with a two-foot perimeter berm located approximately 150 feet from the county road, and two designated field areas that were to be used for disposal (Figures 3 and 6 in Appendix A) (MEC, 1989). The outline of the stockpiling area was faintly discernable at the time of the 1999 PA/SI. Most drainage for the site flows into a low ditch that runs west to east across the southern portion of the site (Wilder, 1999b).

The actual area where sludge was disposed of is located on a flat, mowed grassy area near the runway and likely now includes an area covered by the runway as well. The area that received the sludge material are not visibly distinguishable from the surrounding mowed grass, but several soil cores collected during the 1999 PA/SI investigation featured an atypical green-grey hue indicative of sludge material which may still be identifiable at depth on site (Wilder, 1999a).

The surrounding area consists of residential properties along with commercial and public service buildings. The landscape is dominated by pastures and forests with homes clustered along the county maintained roadways. The site itself is virtually flat and there are no trees or other woody vegetation in the immediate vicinity. The site is located on a plain atop a broad ridgeline running roughly north-south with drainage features flowing to the east and west into the Lake of the Ozarks (Elfrink, 1999, Bachle, 2017a).

2.2 Operational and Site History

The site is a field on the municipal airport for the City of Camdenton officially known as the Camdenton Memorial –Lake Regional Airport (KOZS). Regional flights serve the Lake of the Ozarks regional area. In 1989, the City of Camdenton land-applied sewage sludge from the City Lagoon #3 which received a mix of domestic wastewater and industrial waste from a metal parts manufacturing facility at 221 Sunset Drive. The waters and sludge from the City Lagoon #3 have been found to contain VOCs and metals (Tables 1 and 2). The sludge was applied to an area at the south end of the airport south and east of the runway. A 2002 airport expansion project likely covered a portion of the sludge disposal area soils under asphalt. Further extension of the runway to accommodate larger aircraft is planned in 2018-2019 (Mroczka, 2016).

The City Lagoon #3 is the source for sludge placed at the Camdenton Sludge Disposal Area and the following description of the City Lagoon #3 is included to provide pertinent background information.

The City of Camdenton’s City Lagoon #3 was constructed in 1961 under the State of Missouri Grants Program. City Lagoon #3 was most commonly referred to as the Hulett Lagoon due to its proximity to the Ron Hulett automobile dealership that is located at 249 N. Highway 5 (Wilder, 1999c). The lagoon was also referred to as the Factory Lagoon and by the official name of City Lagoon #3 used here (MEC, 1989, Wilder, 1999c).

Camdenton's City Lagoon #3 operated from 1961 to 1988. From 1967 through 1986 the manufacturing facility located at 221 Sunset Drive approximately 1,000 feet southeast of the lagoon, released untreated wastewater and storm water into the lagoon through a series of "mudpits", or sumps, via a storm sewer (MDNR, 1992). Air conditioning coils were manufactured at the 221 Sunset Drive facility first by Dawson Metal Products (1970-1972), next by Sundstrand Tubular Products (who bought Dawson in 1972 and operated until 1990), and finally by Modine Manufacturing (1990- 2012). Untreated wastewater discharged from the facility was known to have contained several hazardous waste streams including corrosive waste, wastewater treatment sludge from electroplating operations, and waste oil. In addition, residual contaminants associated with degreasing operations, including TCE, were discharged into the mud pits and ultimately into the City Lagoon #3 (Wilder, 1999a). While the TCE and heavy metal contamination originated from the facility at 221 Sunset Drive in Camdenton, the wastes themselves only came under CERCLA jurisdiction after mixing with municipal sewage rendered them exempt from Resource Conservation and Recovery Act (RCRA) regulations.

In 1988, the City of Camdenton began closure of the City Lagoon #3 pursuant to an Industrial Development Grant overseen by Department's Water Pollution Control Program. As per Department guidelines for closing out municipal lagoons, sampling and analysis of the sludge in the lagoon was limited to metals (Al, Cr, Cd, Cu, Pb, Ni, and Zn) and other parameters such as total solids. High levels of chromium, lead, and nickel were detected. The city opted to perform subsurface application by spreading the dried sludge and disking it into the soil. DNR approved the sludge disposal plan on February 22, 1989 (Wilder, 1999a).

The city's engineering consultant, Missouri Engineering Corporation, supervised the lagoon closure project. The contract included specifications for lagoon dewatering, preparation, transportation, and stockpiling of the sludge, as well as disposal by land application. When that portion of the project was completed, an estimated 2,395 cubic yards of sludge had been removed (Cyrus, 1989; McCormick, 1989, Hixson, 1990). The sludge was applied at the Camdenton

Municipal Airport from July 1989 through March 1990. City employees who observed some of the spreading activity reported the sludge was more difficult to spread evenly than was originally anticipated. It didn't dry out completely and would stick together in clumps. Near the end of the process, it was reported that the last several piles of sludge transported to the area were simply dumped into the ditch located about 50 feet north of the circular storage area (Wilder, 1999b). It was not spread, mixed or disked. In March 1990, the land application field was seeded to provide ground cover and prevent erosion.

2.2.2 Allegations of Additional Sludge Disposal Locations

Reports from a concerned citizen were received by the Department on June 20, 2017 suggesting that additional properties aside from the Camdenton Memorial Airport had received waste from the City Lagoon #3 closure in 1989 (Burns, 2017). Department staff did not find evidence to support these claims. Department staff interviewed landowners that had allegedly receiving these wastes, and the property owners confirmed that the sludge they had accepted were from the city's C. P White Lagoon rather than from the City Lagoon #3 (Coleman, 2017, Tidgren, 2017). Current and former City of Camdenton employees also corroborated that there were no additional sludge disposal sites for the City Lagoon #3 wastes (Emry, 2017). Furthermore, the timeline over which the landowners in question had accepted sludge on their properties (late 1990's- early 2000's) had occurred long after the closure of City Lagoon #3 and must have originated from other sources.

2.3 Previous Investigations

2.3.1 Former Hulett Lagoon (City Lagoon #3) Combined PA/SI 1999

Due to concerns about residual hazardous waste contamination at the closed City Lagoon #3, the Department completed a Combined PA/SI investigation of the City Lagoon #3 on March 30, 1999 (Wilder, 1999c).

To characterize condition within the closed lagoon site the Department's Environmental Service Program (ESP) personnel advanced 10 soil borings (Hulett-01 through Hulett-10) utilizing a track-mounted hydraulic soil probe. Eight soil grab samples were collected from the lagoon area and one background sample was collected from outside the lagoon. Figure 2 shows the location of all soil samples collected in the lagoon area during the 1999 PA/SI investigation. All soil samples were analyzed for total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and silver) and VOCs (Wilder 1999c).

Table 2, in Appendix B, presents the analytical results for all soil samples collected by the Department as part of the Hulett Lagoon PA/SI. Three soil samples from the Hulett Lagoon 1999 sampling contained TCE at a detectable level. The concentrations of TCE detected in the three samples from the lagoon exceed the C_{LEACH} value for TCE, which would indicate potential existed for TCE to leach into the saturated zone and result in groundwater contamination above the MCL (MDNR, 1998, Wilder, 1999c). Only one sample from Hulett-04 contained any metals significantly above background. Barium and cadmium were over three times the background levels; however neither metal was present above the SCDM benchmarks or MO ASLs (screening levels at the time) (Table 2).

The 1999 Hulett Lagoon PA/SI concluded that a release of TCE to the Ozark aquifer had occurred from the site. Although the lagoon sludge was removed during closure, residual TCE concentrations were detected in soil near the outfall of the lagoon and in shallow groundwater monitoring wells. To address public concerns regarding potential TCE contamination in Camdenton permanent soil gas monitors were installed on site and soil gas sampling was conducted in February, May and August 2018 by Sundstrand /UTC contractors. Soil gas sampling results from 2018 indicate that, while TCE vapors are present in soils in the area immediately around the former lagoon, the concentration of TCE soil vapor diminishes in samples collected further from the site. Additional soil gas sampling is planned in 2019 to further characterize the extent of TCE soil vapor on site.

2.3.2 Camdenton Sludge Disposal Area Combined PA/SI 1999

In response to residents' concerns about potential contamination the City of Camdenton collected a groundwater sample from a drinking water well on August 3, 1998 located at a residence (later designated 3499 RR3) off of Forbes Road approximately 0.15 of a mile west-southwest of the Camdenton Sludge Disposal site. The sample was sent to the Department's ESP laboratory for

VOC analysis and 13.1 ppb TCE and 0.6 ppb cis-1,2-dichlorothene were detected (Wilder, 1999a). The City of Camdenton collected a second confirmatory sample from the well at 3499 RR3 on August 23, 1998 after purging the lines for at least 20 minutes and had it analyzed at the Department’s laboratories. The sample collected on August 23 was non-detect for all VOCs (Wilder, 1999a).

Concern over potential VOC contamination in the local aquifer following these results prompted the Department to conduct a PA/SI of the Camdenton Sludge Disposal Area site. Source samples of sludge material were collected on January 22, 1999 and although analysis showed that there was metals present above background levels, the concentrations were below relevant cleanup standards. No TCE was detected in source sludge samples collected on site. The sludge disposal area is within the fenced property of the Camdenton Memorial Airport adjacent to an active runway and exposure to surface soils by the public is highly unlikely.

Groundwater samples for the PA/SI were collected on January 6 and 29, 1999. One public water supply well and three private drinking water wells were sampled. Figure 4 in Appendix A shows sample locations for all groundwater samples collected as part of the Camdenton Sludge Disposal PA/SI (Allen, 1999). Sample collection and results from the 1999 PA/SI are summarized below.

2.3.2.1 Department Source Area Sampling - January 22, 1999 (Allen, 1999)

The sludge disposal area was sampled on January 22, 1999 (Figure 5). Ten soil borings (Hulett-11 through Hulett-20) were drilled to collect eight soil/waste source samples from the sludge disposal area and two background samples from outside the area. A membrane interface probe (MIP) equipped with a photo ionization detector (PID) and a flame ionization detector (FID) was employed to generate soil gas data of the subsurface within the sludge disposal area and aid in selection of sampling locations. Small detections on the MIP's PID and FID in borings Hulett 12, 18, and 19 indicated volatile organic compounds were present (Allen, 1999). Surface (0.5'-1') and subsurface samples (5'-8') were collected to locate actual sludge material and attempt to determine whether any contaminants from the sludge may have migrated downward. The background boring was drilled just north of Forbes Road approximately 25 feet southwest of the sludge disposal area.

Table 3, in Appendix B, presents selected analytical results for all soil/waste samples. Source samples were analyzed for VOCs. TCE was not detected in any of the sludge (or soil) samples collected in the PA/SI.

All samples were analyzed for total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and silver) (chemical analytes not-detected in all samples are not listed in Table 3). Green sludge material was encountered in borings Hulett 12 and Hulett 19 from the ditch area. Analytical results from samples 991478 (Hulett 12) and 991483 (Hulett 19) from 0.5'-1' depths showed total levels of chromium, copper, lead, mercury (only in 991478) and nickel (only in 991483) significantly above background. The chromium, copper, and arsenic concentrations exceeded SCDM benchmarks, although it is notable that the arsenic concentrations were less than three times background levels and therefore do not constitute a release to the environment under CERCLA. While chromium was detected at 7,830 mg/kg in Hulett-19 and 1,640 mg/kg in Hulett 12, these concentrations are well below the 180,000mg/kg chromium EPA Regional Screening level which would require cleanup for an industrial site (and below the 120,000 mg/kg chromium EPA Regional Screening Level for residential sites). Ethylbenzene, toluene, and total xylenes were detected in sample 991483 and ethylbenzene was detected at depth in sample 991482 all at levels below levels which would require a cleanup (Wilder, 1999a).

2.3.2.2 Department Groundwater Sampling - January 6, 1999 (Allen, 1999)

Two samples were collected from the private drinking water well at 3499 RR3 on Forbes Road using a 30 second and a 5 minute purge time in an attempt to account for the discrepancy in analytical results in previous samples collected using different evacuation times. The samples were analyzed by the Department laboratory which did not detect any VOCs (including TCE) or metals above screening levels. Later in the day on January 6, an additional water sample was collected by private citizens from the well at 3499 RR3 for independent VOC analysis by Environmental Analysis South, Inc. in Cape Girardeau, MO. The private laboratory analysis showed 20 parts per billion (ppb) TCE from the well sample at 3499 RR3.

The well at the 3496 RR3 residence, located on Forbes Road (approximately 0.25 of a mile southeast of the site) was sampled by the Department on January 6, 1999, and was analyzed by the Department for total metals (arsenic, barium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver) and VOCs. The sample was non-detect for all VOCs (including TCE). Sample results for metals were below all relevant screening levels except for lead which was quantified at 17.7 (thus exceeding the National Secondary Drinking Water Regulation recommended limit of 15 ppb lead). The well was also sampled privately later on January 6, 1999, and analyzed for VOCs by a private laboratory which found 21ppb TCE.

The third well sampled by DNR on January 6, 1999, was at the residence located directly across the road from the 3496 RR3 (County Road 5-120) residence (labeled as "Private Well" on PA/SI groundwater sample map). Sample 991457, collected by Department staff from the private well at the residence across the road from 3496 RR3 was analyzed for total metals (arsenic, barium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver) and VOCs. No metals were detected at concentrations above relevant screening levels and the sample was non-detect for all VOCs.

2.3.2.3 Department Groundwater Sampling - January 29, 1999 (Allen, 1999)

Additional sampling was conducted at the 3496 and 3499 RR3 wells due to the discrepancies in analytical results from the samples collected on January 6, by the property owner and analyzed by Environmental Analysis South, Inc., and those collected and analyzed by the Department.

Due to theories that the TCE was only being detected after a certain amount of purging, several samples were collected from each well at various intervals of evacuation. Samples were collected from the well at 3499 RR3 at the following intervals of evacuation: 15 minutes, 45 minutes and 75 minutes. Samples were analyzed by the Department and split samples were analyzed by two separate private laboratories (Environmental Analysis South, Inc. and Environmental Health Laboratory). No VOCs were detected in any of the samples from 3499 RR3 at the Department's laboratory or either of the private laboratories.

Four samples were collected from the well at 3496 RR3 at the following intervals of evacuation: 15 seconds, 15 minutes, 45 minutes and 75 minutes. Samples were analyzed by the Department and split samples were analyzed by two separate private laboratories (Environmental Analysis South, Inc. and Environmental Health Laboratory). No VOCs were detected in any of the samples from 3499 RR3 at the Department's laboratory or either of the private laboratories (Warren, 1999, Wilder, 1999a).

Also sampled on January 29, 1999, was the Camden County PWSD #2 Well #1. One sample, 991496, was collected from the well for VOCs after evacuating the well for 10 minutes. No VOCs were detected.

2.4 Waste Characteristics

2.4.1 Trichloroethylene -TCE

The primary contaminant of concern for the Camdenton Sludge Disposal Area is trichloroethylene (TCE); a manmade VOC. Records indicate that the sludge from City Lagoon #3 likely contained TCE, although state regulations at the time only required testing of metals contamination and quantitative data on the TCE concentration of the sludge is not available.

The following summary is based on information provided in the Toxicological Profile for TCE (ATSDR, 1996, ATSDR, 2015). TCE is a colorless liquid at room temperature that is nonflammable and has a somewhat slightly sweet odor. Although TCE is mainly used as a solvent to degrease metal parts, it is also used in several household products including; paint removers, adhesives, and spot removers. TCE is a widely used chemical, and approximately 400,000 workers are routinely exposed to it in the United States. TCE quickly evaporates at room temperatures, and is most commonly released to air from industrial processes. When disposed at chemical waste sites it has the potential to enter soil and groundwater. The compound has only slight solubility in water. It is a dense non-aqueous phase liquid (DNAPL), which has a higher density than water (USEPA, 1992).

Once released to the atmosphere, TCE will persist for several hours to several months, until being broken down by sunlight. In surface water, the majority of TCE released will evaporate within several hours to several weeks. Any TCE remaining in the water column will settle to the bottom of the water body since it has a greater density than water. TCE is unlikely to bio-concentrate in aquatic life, or adsorb substantially to sediments and soils. In soils, due to its volatility and low adsorption to soil, TCE will evaporate quickly and/or rapidly leach into the groundwater. Adsorption of TCE to soil organic matter of clay matrices may occur, but does not usually lead to retention of high concentrations of the chemical in surface soils. Once in the groundwater, liquid TCE will migrate downward until reaching a less permeable layer. Microbial degradation of TCE in anaerobic groundwater can produce cis- 1,2- DCE, 1,1-DCE and vinyl chloride.

The most common exposure routes for TCE is through inhalation of vapors or direct contact of the solvent with skin. Dizziness, sleepiness, headaches, and skin rashes can occur following acute exposure of individuals to high levels of TCE. There is strong evidence that TCE can cause kidney cancer in people and some evidence for liver cancer and malignant lymphoma. The International Agency for Research on Cancer (IARC) and USEPA have classified TCE as carcinogenic to humans. USEPA designates TCE as a CERCLA hazardous substance with a reportable quantity pursuant to the Clean Water Act, Clean Air Act, and Resource Conservation and Recovery Act. A recent review of developing toxicity and exposure data for TCE by the USEPA in 2016 resulted in a lowering of the recommended health-based screening and action levels for use in CERCLA site assessment investigations (USEPA, 2015a).

2.4.2 Chromium and Hexavalent Chromium

In addition to TCE, Chromium is another contaminant of concern for the Camdenton Sludge Disposal Area. Except as otherwise noted, the information provided herein was taken from the Toxicological Profile for Chromium (ATSDR, 2012a, ATSDR, 2012b).

Chromium is a naturally occurring element found in rocks, animals, plants and soil. The most common forms are trivalent chromium (Cr^{+3}), and hexavalent chromium (Cr^{+6}). Chromium compounds are stable in the reduced Cr^{+3} state (Palmer and Puls, 1994) and occur in nature with this valence charge in ores, such as ferrochromite ($FeCr_2O_4$). Cr^{+3} is an essential micronutrient that helps the body use sugar, protein and fat (Hewlings and Medeiros, 2009). Cr^{+6} is the second most stable, oxidized state. Hexavalent chromium is rarely found in nature, but may be produced from anthropogenic sources and is more toxic to humans. Cr^{+6} occurs naturally in the relatively rare minerals crocoite ($PbCrO_4$) and Hashemite ($BaCrO_4$) (Puls et al., 1994). Both Cr^{+3} and Cr^{+6} are used for chrome plating, making dyes and pigments, leather tanning and wood preservation.

The solubility of chromium compounds varies, depending primarily on the oxidation state. Trivalent chromium compounds, with the exception of those bound to acetates, hexahydrates of chloride, and nitrate salts, are generally insoluble in water. The zinc and lead salts of chromic acid are practically insoluble in cold water. The alkaline metal salts (e.g., calcium, strontium) of chromic acid are less soluble in water. Some hexavalent compounds, such as Cr^{+6} oxide (chromic acid), and the ammonium and alkali metal salts (e.g., sodium and potassium) of chromic acid are readily soluble in water. The Cr^{+6} compounds in solution are reduced to the trivalent form in the presence of oxidizable organic matter (Puls et al., 1994a). However, in natural waters where there is a low concentration of reducing materials, Cr^{+6} compounds are more stable.

Bioaccumulation of chromium from soil to aboveground parts of plants is unlikely to occur. There is no indication that bio-magnification of chromium occurs along the terrestrial food chain (soil-plant-animal).

Total chromium concentrations in U.S. soils range from 1 to 2,000 mg/kg, with a mean of 37.0 mg/kg. The average chromium concentration in agricultural soils of Camden County in Missouri is 52 mg/kg, which is slightly less than the statewide average of 54 mg/kg in Missouri (Tidball, 1984). Chromium in soil is mostly present as insoluble carbonate and oxides of Cr^{+3}; limiting mobility. The solubility and mobility of Cr^{+3} in soils may increase due to the formation of soluble complexes with organic matter in soil with a lower soil pH, potentially facilitating complexation. The treatment of the soils with liming agents to increase the pH within the Camdenton Sludge Disposal Area likely reduced the probability that chromium will be leached into shallow groundwater on site.

3.0 WASTE/SOURCE SAMPLING

Waste/Source sampling was not conducted during this Site Reassessment investigation. A detailed summary of past waste/source sampling from the 1999 Combined PA/SI investigation for Camdenton Sludge Disposal Area can be found in Sections 2.3.2 and 2.3.2.1.

4.0 GROUNDWATER PATHWAY

4.1 Hydrogeologic Setting

The site lies in the Salem Plateau groundwater province which is located in the northern portion of the Ozark Highlands physiographic province (Miller and Vandike, 1997, Missouri Water Atlas, 1986). The topography of the Salem Plateau is characterized by rolling uplands with rugged hills dissected by entrenched, narrow stream valleys. Karst features, such as springs, sinkholes, and losing streams, are common (Bachle, 2017a, Elfrink 1999).

4.1.1 Soil

Soils in the Camdenton Sludge Disposal Area belong to the Lebanon, Viraton, and Union silt loams series'. Perched water may occur in Viraton soils due to reduced infiltration where an 11" thick fragipan feature reduces infiltration rates (fragipan is a domelike accretion of fine silts at depth - located on site at approximately 20" below the soil surface- that slows infiltration rates [Dingman, 2002, USDA, 1994]). Viraton silt loam soils can be acidic, neutral or slightly alkaline (pH 4.5 to 7.3) with low permeability (0.6 to 2.0 inches per hour at the surface and as low as <0.06 inches per hour at 19-30" depth where fragipans are present [USDA, 1994]). The subsoils on site are comprised of cherty clay residuum. The soil and residuum are approximately 10 ft. deep on site.

4.1.2 Ozark Aquifer

The Ozark Aquifer, which includes all bedrock units above the Cambrian-age Derby-Doerun Dolomite, is the shallowest aquifer beneath site (Table 4). The total thickness of the aquifer is approximately 950 feet. Depth to groundwater within the Ozark aquifer is estimated to be from 235- 290 feet below ground surface (bgs) on site. In some locations perched groundwater may exist at lesser depths below the surface. The area surrounding the Camdenton Sludge Disposal Area is considered a groundwater recharge zone with characteristic downward flow gradients. Analysis of local groundwater identified two separate pathways with shallow groundwater flowing eastward to surface in Dry Auglaize Creek and deeper groundwater flowing to west to the Niangua Arm of the Lake of the Ozarks. Discrepancies in groundwater flow direction may be due dissolution features creating conduits in the karst environment. While past dye trace studies have shown multiple flow pathways for area groundwater the potentiometric surfaces display an overall declining gradient towards the Lake of the Ozarks and therefore the dominant groundwater flow direction is most likely to the north and west from the site.

The Ordovician aged Roubidoux formation is the first bedrock layer encountered below the quaternary aged soil and residuum on site. Missouri Geological Survey staff estimated that the Roubidoux formation is approximately 50 ft. thick at the Camdenton Sludge Disposal Area site which is typically not thick enough to produce usable quantities of groundwater (Elfrink, 1999). The Roubidoux formation is composed of clayey residuum, sandstone and sandy dolomite with a hydraulic conductivity of $1x10^{-3}$ cm/sec (Table 4).

The Gasconade Dolomite forms another Ordovician aged lithological layer situated directly beneath the Roubidoux formation on site. The upper portions of the Gasconade Dolomite may provide some resistance to contaminants entering the aquifer as it has been described as competent low permeability bedrock (Elfrink, 1999). However, the presence of karst features and penetration of this stratum by poorly cased wells could form preferential pathways for contaminant dispersal. The Gasconade Dolomite is comprised of cherty dolomite, minor factions of sandstone and shales with an overall hydraulic conductivity of $1x10^{-6}$ m/sec.

The Gunter Sandstone formation is located below the Gasconade Dolomite. This layer is approximately 25 feet thick at the site and is the deepest set Ordovician aged formation below the site. The Gunter Sandstone is a pure sandstone feature with relatively high hydraulic conductivity ($1x10^{-4}$ cm/sec) that is known to produce large quantities of groundwater.

Cambrian rocks in the Camdenton area were deposited in a complex depositional environment.

The Camdenton Sludge Disposal Area is located near the western margin of a Cambrian-age intra-shelf sedimentary basin known as the Central Missouri Basin (Palmer and Hayes, 1997). During Cambrian time, the Camdenton area was part of an emerging tectonic feature known as the Lebanon Arch. The north-south trending Lebanon Arch consists of carbonate platform rocks that in some areas, thin over Precambrian highlands (Gregg et. al., 1989).

Because of the tectonic setting, Cambrian beds in the Camdenton area are difficult to categorize, and "layer-cake" stratigraphy should not be assumed. Dramatically different lithologies and abrupt facies changes are depicted in area well logs (Figure 7). Several minor faults are present within four miles of the site (Figure 8).The Cambrian aged deposits of the Eminence dolomite make up the next geologic layer below the Ordovician aged Gunter Sandstone. This layer is comprised of approximately 550 ft. of cherty dolomite which has a conductivity of $1x10^{-5}$ cm/sec.

The Potosi Dolomite lies below the Eminence dolomite and is approximately 50 ft. thick on site. Comprised of Cambrian aged deposits of dolomite with abundant quartz and druze quartz, the Potosi dolomite has relatively high hydraulic conductivity ($1x10^{-4}$ cm/sec) and produces large quantities of water to area wells. The Potosi dolomite is the deepest geologic layer of the Ozark aquifer.

4.1.3 St. Francois Confining Unit

The Cambrian-age Derby- Doerun dolomite and Davis Formation make up the St. Francois Confining Unit beneath the site. The Derby- Doerun dolomite and Davis Formation are made up of slow permeability shaley dolomites and shales. The St. Francois Confining Unit is approximately 160 ft. thick below the site (Table 4). The St. Francois Confining Unit is considered a reliable aquitard capable of arresting further downward migration of contaminants reaching that depth.

4.1.4 St. Francois Aquifer

None of the drinking water wells within 4 miles of the site penetrate the Cambrian-age Bonneterre Formation and Lamotte Sandstone that constitutes the St. Francois aquifer. This 390- 400 foot thick formation consists of dolomite, limestone, sandstone, and arkosic conglomerates. The St.

Francois aquifer has hydraulic conductivities of 1×10^{-5} cm/sec in both the Lamotte Sandstone and dolomite and limestones of the Bonneterre portions (Table 4). Groundwater flow direction within the McNairy aquifer is not known for this location.

4.1.5 Basement Confining Unit

The Cambrian aged deposits of the Basement Confining Unit lie below the Lamotte Sandstone formation on site. This formation is comprised of igneous and metamorphic rocks and does not yield water to wells used in this area. Therefore, aquifer characteristics of the Basement Confining Unit are poorly known.

4.2 Groundwater Targets

Groundwater use within four miles of the site is extensive. Sixteen public and 272 private wells provide groundwater to residents within four miles of the site (Bachle, 2017b). Approximately 5,315 individuals rely on groundwater from public and private wells within 4 miles of the site (Table 5). Locations of wells within 4 miles of the site can be viewed in Figure 9 in Appendix A. A description of the well use from the 1999 Camdenton Sludge Disposal Area PA/SI (with relevant updates) follows (Wilder, 1999a).

4.2.1 Public Drinking Water Wells

Public Water Supply District #2 (PWSD2) of Camden County Well #1 is located just east of Highway 5 at the Camdenton Memorial Airport, approximately 0.6 of a mile northwest of the sludge disposal area. The well was drilled in 1974 to a total depth of 848 feet with 330 feet of 6 inch steel casing. The pump is set at 415 feet. PWSD2 personnel reported that Well #1 is used as a reserve well, and is only turned on once a week for a maintenance check. PWSD2 Well #2 is located just east of Highway 5, approximately 3.1 miles south-southwest of the site. PWSD2 Well #2 is the primary well that supplies 99% of the water for the district (Wilder, 1999a). Camden County PWSD2 served 800 people in 1989 and has grown to serve 1,400 residents in 2018 (McCormick, 1989, MDNR, 2017a, MDNR, 2018).

The City of Camdenton's Rodeo well is located on Rodeo Road in the City of Camdenton, approximately 3.6 miles northwest of the site. The Rodeo well was drilled in 1961 to a total depth of 940 feet with 450 feet of eight-inch steel casing. The pump is set at 420 feet (MDNR, 2017b). The Rodeo well served an apportioned 993 people in 1999 and would serve close to 1,000 apportioned customers if it were running but it is currently on standby and is only pumped in emergencies (McCormick, 1989, MDNR, 2017a).

The other public drinking water wells within the four mile radius are actually privately owned ‘community’ drinking water wells which have fifteen or more service connections and provide drinking water to twenty five or more people and therefore designated as ‘public wells’ by the departments public drinking water branch (MDNR, 2017a). These ‘community wells’ may serve mobile home parks businesses or institutions.

4.2.2 Private Drinking Water Wells

Within four miles of the site, there are 288 wells recorded in the Missouri Geological Survey (MGS) databases. The MGS Well Wellhead Protection Section’s Water Well Information System (W.I.M.S.) database contains information on wells drilled since 1987 (Bachle, 2017b). Some wells may no longer be active, and many active wells may not be recorded in DGLS databases. Table 5 presents the breakdown of wells within four miles of the site (Bachle 2017b). The closest private well is located approximately an eighth of a mile west of the site and was sampled in the 1999 PA/SI as well as in the Site Reassessment.

4.3 Groundwater Sampling

4.3.1 SR Groundwater Sampling Methods

Drinking water well samples were collected from the closest available point near the well head. Taps were opened at a high flow for five minutes. Specific conductivity, pH, and temperature were monitored during purging. Following the initial five minutes of purging the wells were allowed to continue to run for an additional three minutes and field measurements were collected again. If all parameters were stabilized, (pH within 0.2 units, temperature and specific conductivity within +/- 10%) a sample was collected. If water quality parameters were not within stable range then the tap was allowed to continue to flow for an additional three minutes and this sequence was repeated until parameters stabilized. Groundwater samples collected for dissolved metals analysis were filtered in the field prior to submission to the laboratory. Samples collected for VOC analysis were preserved with hydrochloric acid (HCl) and the samples gathered for metals analysis were preserved with nitric acid (HNO_3). The samples were labeled, recorded on chain of custody forms and stored on ice until submission to the laboratory for analysis.

Locational data was collected at each wellhead using a Trimble GeoExplorer handheld global positioning system (GPS) with a minimum logging time of 60 seconds, and corrected using post-processing.

All groundwater samples were analyzed for VOCs and select metals (barium, chromium, copper, lead and zinc). Due to concerns that hexavalent chromium may be present, it was determined that drinking water samples would be analyzed for hexavalent chromium in the event that total chromium exceeded 3.5 µg/L (representing the EPA Screening Level for hexavalent chromium at the $1x10^{-4}$ risk level). This level was chosen to avoid screening out samples that could contain harmful quantities of hexavalent chromium even though the total chromium may be under the 100 µg/L EPA Maximum Contaminant Level (MCL). One sample exceeded the 3.5 µg/L threshold from the Sampling and Analysis Plan (SAP) and was submitted for hexavalent chromium analysis by a contract laboratory along with two background samples for comparison.

4.3.2 Background Wells Sampling Locations

Department staff identified two private wells (Locations 118 and 123) that were estimated to be beyond the influence of the Camdenton Sludge Disposal Area site (at a distance greater than 4 miles [Figure 11]). Samples were collected from these wells on October 2, 2017 and analyzed for VOCs. Both wells were resampled on October 19, 2017 and analyzed for metals in order to establish background groundwater conditions in the Ozark Aquifer. Follow-up sampling for lead was conducted at Location 123 on February 13, 2018 (further discussed in Section 4.4.2).

4.3.3 Private Wells Sampling Locations

The department's ESP and Hazardous Waste Program (HWP) staff sampled 11 private drinking water wells generally located within one half mile of the site on October 2, 2017, and analyzed for

VOCs and select metals (Figure 10, Appendix A). The private wells at Locations 109, 110 and 111 had been previously sampled for the 1999 PA/SI (referred to then as “Private Well”, 3496 RR3 Private Well and 3499 RR3 respectively) and the results are discussed in Section 2.3.2 of this report.

The same 11 private wells were resampled and analyzed for metals on October 19, 2017, as part of a follow up effort to confirm initial findings and to clear up an anomaly in the original sample results (discussed in Section 4.4.1).

4.3.4 Public Well (Location 106) Sampling Location

The department’s ESP and HWP collected a sample from the Camden County Public Drinking Water Supply District # 2 (PWSD2) backup Well #1 on October 2, 2017, for analysis of VOCs and select metals. The PWSD #2 Well #1 is located alongside the entrance to the KOZS airport entryway at a distance of just over one half mile from the Camdenton Sludge Disposal Area site (which is located at the other end of the airport property [Figure 10]). The same well was sampled during the 1999 PA/SI investigation of the Camdenton Sludge Disposal Area and was analyzed for VOCs and metals (discussed above in Section 2.3.2). The well was resampled on October 19, 2017, and submitted for analysis of total and dissolved chromium, hexavalent chromium, and zinc.

4.4 Groundwater Sample Results

4.4.1 Background Wells

Sampling documentation and analytical results are provided in Appendix D. Results are summarized in Tables 6 and 7 of Appendix B. No VOCs were detected in the two background wells. The sample from Location 123 contained 23.7 µg/L lead, which exceeds the USEPA National Primary Drinking Water Regulations Action level for lead of 15µg/L. Follow-up sampling was conducted at this location on February 13, 2018 to confirm the initial findings. Samples were collected from the wellhead, the kitchen tap, the refrigerator tap (charcoal filtered) and from a countertop Britta (charcoal) filter pitcher.

Additional sampling conducted at Location 123 revealed that the water in the indoor faucet also contained lead at concentrations above the Action Level. However, the filtration systems that the homeowner was using had either reduced the lead (pitcher filter) or had completely eliminated the lead (refrigerator filter). The wellhead sample contained 28.5 µg/L lead; 27.9 µg/L lead was detected at the kitchen faucet; 10.7 µg/L in the filter pitcher; and <0.5µg/L at the refrigerator. The homeowner at Location 123 was informed of the lead content of their well water and advised by department staff to filter their drinking water before consuming it. The contaminated well was referred to the USEPA Region 7 Removal Program for potential action as a part of the Central Mining District Lead - Camden County (EPA ID No MON000705679.) response.

Due to elevated lead detected in the well water at Location 123, thought to be related to lead mining in the area, it was determined that the well may not be representative of general water quality conditions in the Ozark Aquifer. Therefore, only water quality data from well location 118 were used to represent background groundwater conditions for the site (Table 7). The background sample from location 118 did not detect any total chromium and had 0.013 µg/L of hexavalent chromium which is below all of the relevant screening levels. Lead was not detected in the Location 118 sample. Although barium, copper and zinc were measured at low levels in the groundwater sample from Location 118, no metals were detected at levels above the National Primary or Secondary Drinking Water Standards (Table 7).

4.4.2 Private Wells

Sampling documentation and analytical results are provided in Appendix D. Results are summarized in Tables 6 and 7 of Appendix B. No VOCs (including TCE) were detected in any of the private drinking water well samples. Chromium was not detected in any of the private wells using EPA method 200.7 for analysis (a matrix interference was identified with EPA method 200.8 and the results were flagged with a "(k)"- matrix interference is described below in section 4.4.3). Barium was detected in all samples, but not at concentrations significantly above background (greater than 3x), nor above the MCL. Copper and zinc were detected in some wells at concentrations significantly above background, but below their respective Secondary MCLs. Copper was detected above background levels in groundwater samples from private wells at

Locations 101, 103, and 111, but all the detections were all at least one order of magnitude below the Secondary MCL of 1,300 µg/L (USEPA, 2015b, USEPA, 2017). Zinc was detected at concentrations above background levels in groundwater samples from all private wells except Locations 105 and 108, however, these concentrations were an order of magnitude below the Secondary MCL of 5,000 µg/L. Lead was detected above background levels in groundwater samples from well Locations 101, 111, and "background" Location 123 (see discussion of Location 123 well results in Section 4.4.1). Lead levels only exceeded the 15 µg/L National Primary Drinking Water Standards Action Level at Location 111 (63.6 µg/L).

The well at Location 111 was resampled on October 19, 2017 to confirm the lead detection. The home has a water softener that serves the kitchen and bathroom taps. Samples were collected from near the wellhead (pre-softener) and from the kitchen tap. The wellhead sample contained 28.8 µg/L lead, confirming the previous finding. Analysis of the kitchen faucet sample was non-detect for lead, indicating that the water softener was reducing the lead concentration.

4.4.3 Public Well (Location 106)

Sampling documentation and analytical results are provided in Appendix D. Results are summarized in Tables 6 and 7 of Appendix B. No TCE or other VOCs were detected in the public well. Chromium, lead and zinc were detected at concentrations above the background well (Location 118) levels, but all results were far below the USEPA's National Primary or Secondary Drinking Water Standards.

Total chromium was detected during both the October 2, 2017 (3.25 µg/L) and October 19, 2017 (4.41 µg/L) sampling events (dissolved chromium was non-detect – see Section 4.4.1). Although these concentrations are well below the National Primary Drinking Water Standard MCL for total chromium of 100µg/L, the October 2nd sample result exceeded the criteria of 3.5 µg/L established in the SAP for triggering analysis of the sample for hexavalent chromium (Brown, 2017). Therefore, the samples collected on October 19, 2017 from both the public well and the background wells were submitted for analysis of hexavalent chromium. Hexavalent chromium was detected in the public well at 0.31 µg/L which exceeds the background concentration at well

Location 118. Hexavalent chromium is not addressed under the National Primary or Secondary Drinking Water Regulations, nor are there benchmarks available in the USEPA Superfund Chemical Data Matrix table (USEPA, 2018a). However, the 0.31 µg/L hexavalent chromium detected in the public well is below the 3.5 µg/L (10^{-4} risk level) USEPA Removal Management Levels for hexavalent chromium of (USEPA, 2018c). However, new toxicity information for hexavalent chromium is currently being evaluated at both the state and federal level, and these benchmarks are under review (Hartman, 2018).

4.4.2 Quality Control

A trip blank was processed and analyzed for VOCs along with the groundwater samples collected on site during the sampling event conducted on October 2, 2017. No VOCs were detected in the trip blank.

Duplicate groundwater samples were collected on October 2, 2017, from the private well at Location 109. Table 8 provides a comparison of results for the duplicate samples. Precision, measured as the relative percent difference between results for analytes detected in both samples ranged from 0.0 % (no difference) for dissolved barium and zinc, to 5.5% in total copper. This level of precision is within the criteria of 30% RPD specified in the SAP (Brown, 2017). When multiple samples were identified with greater dissolved chromium results than total chromium results, the samples were re-run using an alternate USEPA approved method not subject to the matrix interference (described in greater detail below in 4.4.3).

4.4.3 Laboratory Matrix Interference

In addition to VOCs, all water samples were analyzed for both total and dissolved metals. Samples collected for total metals analysis are subjected to an acid digestion process in the laboratory in order to render all metals in the sample available for measurement, including any associated with suspended particulates. Samples collected for dissolved metals analysis are first field-filtered to remove particulates prior to submitting to the laboratory. These samples are not subjected to the acid digestion process in the laboratory since all the particulates have been removed and any metals remaining in the sample should already be in dissolved form. Therefore, the dissolved metal content of any sample is a subcomponent of the total metal content, and should always be equal to or lower in concentration that the corresponding total metal result.

The October 2, 2017, samples were analyzed by EPA Method 200.8. Non-detect results were reported for total chromium in all samples except at Location ID 106 (Table 6). However, dissolved chromium was detected in every sample. Due to this anomaly, the department resampled all of the wells on October 19, 2017 and submitted them again for analysis of total and dissolved metals by EPA Method 200.8. Results for the resampled wells were identical as before with dissolved chromium concentrations greater than the total chromium, again except for Location ID 106.

The department's laboratory investigated this anomaly and determined there was a false positive matrix interference encountered during analysis of the dissolved metals samples (Thoenen, 2017). The acid digestion process conducted on the samples for total metals analysis (but not on samples for dissolved metals) was found to have removed this matrix interference.

In order to confirm that this was the cause of the false positive interference, remaining sample from all of the wells collected during both of the October sampling events were analyzed using EPA Method 200.7, an alternative method which is not susceptible to the matrix interference problem encoutered with EPA Method 200.8. Results of the reanalysis revealed no detectable dissolved chromium in any of the samples, confirming there had been a false positive interference on the dissolved metals samples analysed using EPA Method 200.8.

Based on these findings, the data indicate that no dissolved chromium is present in any of the well samples collected and that total chromium is only present at low concentration in one of the wells (discussed above in Section 4.4.3).

4.5 Groundwater Conclusions

Results from private and public wells in the vicinity of the site collected in 1999 and 2017 by the department do not document a release of VOCs at the Camdenton Sludge Disposal Area site.

The groundwater sample results from the SR are also largely consistent with the results of the 1999 SI groundwater sampling. Some of the same wells were sampled during both investigations and the groundwater results are similar. The only outliers are the privately collected groundwater samples in the 1999 PA/SI that were not subject to quality assurance protocols during sampling and were analyzed by private laboratotories. While the initial privately collected and analyzed well samples from 1999 detected TCE, samples collected by department personnnel and analyzed at Department laboratory were unable to replicte these results. Likewise, no VOCS were detected in any of the samples collected and analyzed by MDNR personnel in either the 1999 SI or the 2017 SR sampling.

Several metals have been detected in groundwater samples collected in October 2017, at levels greater than three times the concentrations found in one background well. Chromium, copper, and lead were found at levels significantly greater than background concentrations. However, only lead at one well was found in one well above the MCL. Chromium and copper and did not exceed Primary or Secondary MCLs in any wells.

Lead was not one of the contaminants found at high concentrations in the sludge itself. The lead found in these wells is likely caused by aging pipes and equipment or from historical lead mining activities in the area. While lead was detected in soils at greater than three times background levels in the 1999 Camdenton Sludge Disposal Area PA/SI investigation, it was not above the USEPA Residential Removal Management Level of 400 mg/kg (USEPA, 2018c). The highest lead concentration detected in the 1999 soil sampling on site was 121 mg/kg, which is highly unlikely to result in groundwater contamination observed in the nearby well.

While 4.41 µg/L of total chromium was detected in the public well at Location 106 it is below the National Primary Drinking Water Standards level of 100 µg/L chromium. The state of Missouri standards for hexavalent chromium for drinking water remain under review by the Missouri Department of Health and Senior Services at this time. The 0.31 µg/L of hexavalent chromium detected in the County well at Location 106 is below the 3.5 µg/L Removal Management Level

(USEPA, 2018c) at which remedial action would occur. Given that the Camden County PWSD#2 Well #1 is only utilized on an emergency basis the hexavalent chromium levels are unlikely to pose a risk to consumers, who are regularly served by another well located over three miles from the site. In the event that the PWSD#2 Well #1 is selected for regular use it would be subject to sampling by the department's Public Drinking Water Watch to ensure water quality.

Migration of metals from the sludge to groundwater would have been limited by the application of lime to adjust soil pH after the sludge was land-applied in 1999. Any metals that are leached into the subsurface would be further slowed upon contacting the calcareous limestone bedrock with cations such as chromium (+3) precipitating out of the water column in areas with high pH groundwater (Puls et al., 1994). The expansion of the airport runway (Mrockza, 2016, Coleman, 2017) covered a portion of the sludge disposal area, which would further limit infiltration and potential leaching of metals from residual sludge material.

No further assessment of chromium or other metals is needed at this time.

5.0 SURFACE WATER PATHWAY

5.1 Hydrologic Setting

The Camdenton Sludge Disposal Area is situated near the crest of broad ridgetop that acts as the drainage divide between streams draining northwest, toward the Niangua Arm of the Lake of the Ozarks and streams draining east, toward the Dry Auglaize Creek. South and east of the site, unnamed streams flow southeast toward Forbes Branch. The natural landforms and drainage patterns at the site have been partially obscured by airport construction and soil disposal. The site itself has been leveled; while the surrounding terrain exhibits low natural relief (2% to 4% slopes). Land use patterns for the surrounding upland near the site include residential and agricultural properties with some light-industrial use. The steeper slopes are generally forested (Elfrink, 1999).

Surface runoff from the sludge disposal area flows eastward for several hundred feet to an unnamed intermittent stream, which then flows for one mile before entering the intermittent Forbes

Branch, and flows another 1.2 miles before entering the perennially-flowing Dry Auglaize Creek. Both Forbes Branch and Dry Auglaize Creek are losing streams. Because the overland flow distance to the nearest perennial surface water is more than two miles, the surface water pathway is not evaluated for this site (Elfrink, 1999, Bachle, 2017a).

5.2 Surface Water Conclusions

The surface water pathway was not evaluated due to an overland flow distance to a perennial stream greater than two miles.

6.0 SOIL EXPOSURE AND AIR PATHWAYS

6.1 Soil Physical Conditions

The native soils in the vicinity of the Camdenton Sludge Disposal Area are Lebanon and Variton silt loams (Figure 12). Both Lebanon and Variton silt loam soils are deep, moderately well-drained soils typical of ridgetops. Permeability is moderate, although a shallow fragipan, if present, may perch water (Dingman, 2002). Surface soils on site may have been disturbed during airport construction and sludge disposal activities and typical structural features may no longer exist.

The 40 acre sludge disposal site is an open field with grassy vegetation. There is no visible sludge on the surface. The sludge was reportedly spread, mixed, and disked into the native soil (except for several piles in the ditch) and the area was then seeded. Visible sludge was only encountered in two of nine soil borings at depths ranging from 0.5’ to 1.0’ depth in the disposal area during the 1999 PA/SI sampling event. It was green in color and easily distinguishable from the surrounding soil. The airport property is fenced preventing individuals from accessing the former sludge disposal area. A portion of the sludge disposal area has been covered by asphalt during runway extension activities and is no longer exposed at the surface. The remainder of the former sludge disposal area is covered by grasses and exposure to surface soils is unlikely to occur.

6.2 Soil and Air Targets

Residential areas are located immediately west, east, and south of the site. Two homes are located on County Road 5-120 within 0.25 of a mile of the site. The residence with the corresponding groundwater sample of 3499 RR3 (in the 1999 PA/SI report) is within 400 feet of the western edge of the site (Wilder, 1999a).

A portion of the City of Camdenton lies within four miles of the site (Bachle, 2017a). Camdenton had an estimated population of 2,544 people in 1990 and has grown to approximately 3,700 in 2019 (USDC, 1991, USDC, 2017). Table 9 in Appendix B, presents a breakdown of the number of people estimated to be within a four-mile radius of the site.

6.3 1999 PA/SI Soil Sampling

Soil sampling in the sludge disposal area was conducted as part of Waste Source sampling on January 22, 1999, as a part of the PA/SI investigation and is summarized above in Section 2.3 of this report (Previous Investigations). No soil samples were collected from nearby residential properties during the PA/SI or this SR as they were located over 400 feet from the sludge disposal area and sludge was not suspected to have migrated from that area over time.

6.4 Soil and Air Conclusions

Over 2,000 cubic yards of sludge from the City Lagoon #3 (Hulett Lagoon) was deposited in a 20-40 acre tract at the Camdenton Sludge Disposal Area site in 1989. The majority of 1999 PA/SI sampling focused on the region near the main ditch in the disposal area. Reportedly, several loads of sludge were deposited into this ditch near the end of the project without any mixing, disking, or spreading. Recognizable sludge material was encountered in two soil borings from the ditch. Levels of chromium, copper, lead, and nickel were documented significantly above background in these two samples. However, chromium was the only compound detected at a level exceeding the SCDM benchmarks. TCE was not detected in any of the eight soil samples collected from the disposal area in 1999.

Residual sludge material was visible in two of the PA/SI soil samples collected in 1999 near the surface (0.5'-1' depth), but the field is well vegetated and is not currently used for any purpose. The risk of exposure to trespassers or passers-by is likely to be minimal. Airport runway expansion has covered a portion of the original sludge disposal area further reducing exposure risk on site. Residential areas are located immediately west, east, and south of the site. Two homes are located on Forbes road within 0.25 of a mile of the site. Access to the site is restricted by fencing and not open to the public. There is no current exposure to residual sludge material disposed of at the airport.

The air exposure pathway was not analyzed during this investigation.

7.0 SUMMARY AND CONCLUSIONS

The Site Reassessment investigation was initiated on June 30, 2017 in response to citizen concerns that area groundwater may have been impacted by the sludge disposal area, and to investigate allegations that additional locations besides airport had been used as sludge disposal sites. Groundwater samples were collected from 11 private wells and one public well within a half mile of the site. No TCE or other VOCs were detected in the groundwater samples collected by the department in 2017.

The Camdenton Sludge Disposal Area site consists of 40 acres of open field where sludge from the closure of the TCE contaminated City Lagoon #3 (formerly known as Hulett Lagoon) was disposed of in 1989. City Lagoon #3 had received wastes from a manufacturing facility at 221 Sunset Drive which released wastes containing TCE and metals such as copper and chromium. The disposal of sludge wastes from City Lagoon #3 was approved by the department following testing for metals content. The sludge was not tested for TCE at the time. City Lagoon #3 sludge was land-applied at a field on the south side of the Camdenton Regional Airport property. The sludge was mixed with native soil and liming agents were applied to limit metal mobility.

Concerns regarding potential TCE contamination in area wells prompted the department to conduct a Combined Preliminary Assessment/Site Inspection investigation in 1999. The department's sampling of sludge material, surrounding soil and groundwater did not detect TCE during the 1999 investigation. Isolated pockets of sludge materials were encountered and sampled in the 1999 investigation. The only metal detected above background and cleanup levels was chromium in two samples that were identified as sludge. Groundwater samples collected by the department in 1999 from three private wells and one public well near the site did not document levels of chromium or other metals above Primary or Secondary Drinking Water Standards.

Site Reassessment groundwater sampling included sampling 11 private and one public drinking water well in October 2017. No VOCs, including TCE, were detected in any of the wells. Chromium was detected in the (backup) Camden County PWSD #2 Well #1 at concentrations below the National Primary Drinking Water Standard MCL. Hexavalent chromium was detected at 0.31 µg/L, which is below the USEPA Removal Management Level of 3.5 µg/L.

Two of the wells sampled during the Site Reassessment had elevated lead concentrations which are not attributable to the site and likely due to residual contamination from lead mining in the area or deteriorating pipes. One of the wells with elevated lead concentration is several miles from the site and was originally designated as a background well. The Department referred this well to the USEPA Region 7 Removal Program to address the lead contamination under the Central Mining District Lead - Camden County site. The other well had a treatment system that removed lead before consumption.

While the sludge wastes applied on site in 1989 contained hazardous substances, sampling of sludge material and surrounding soil in 1999 did not document a release of hazardous substances at levels above cleanup standards. No TCE or other VOCs were detected in waste source sampling in the sludge disposal area. Results from private and public well sampling conducted in the vicinity of the Camdenton Airport in 1999 and 2017 do not document a release of hazardous substances, including TCE, from the Camdenton Sludge Disposal Area site to the groundwater. All metals (aside from lead not related to the site) detected in groundwater samples were under levels allowable under the National Primary or Secondary Drinking Water Regulations.

No further assessment or action at the Camdenton Sludge Disposal Area site under CERCLA is warranted at this time.

Prepared by: Keith Brown

Keith Brown, Environmental Specialist, Site Assessment Unit

Reviewed by:

Martin Kator, Chief, Site Assessment Unit

Approved by: Valerie Wilder

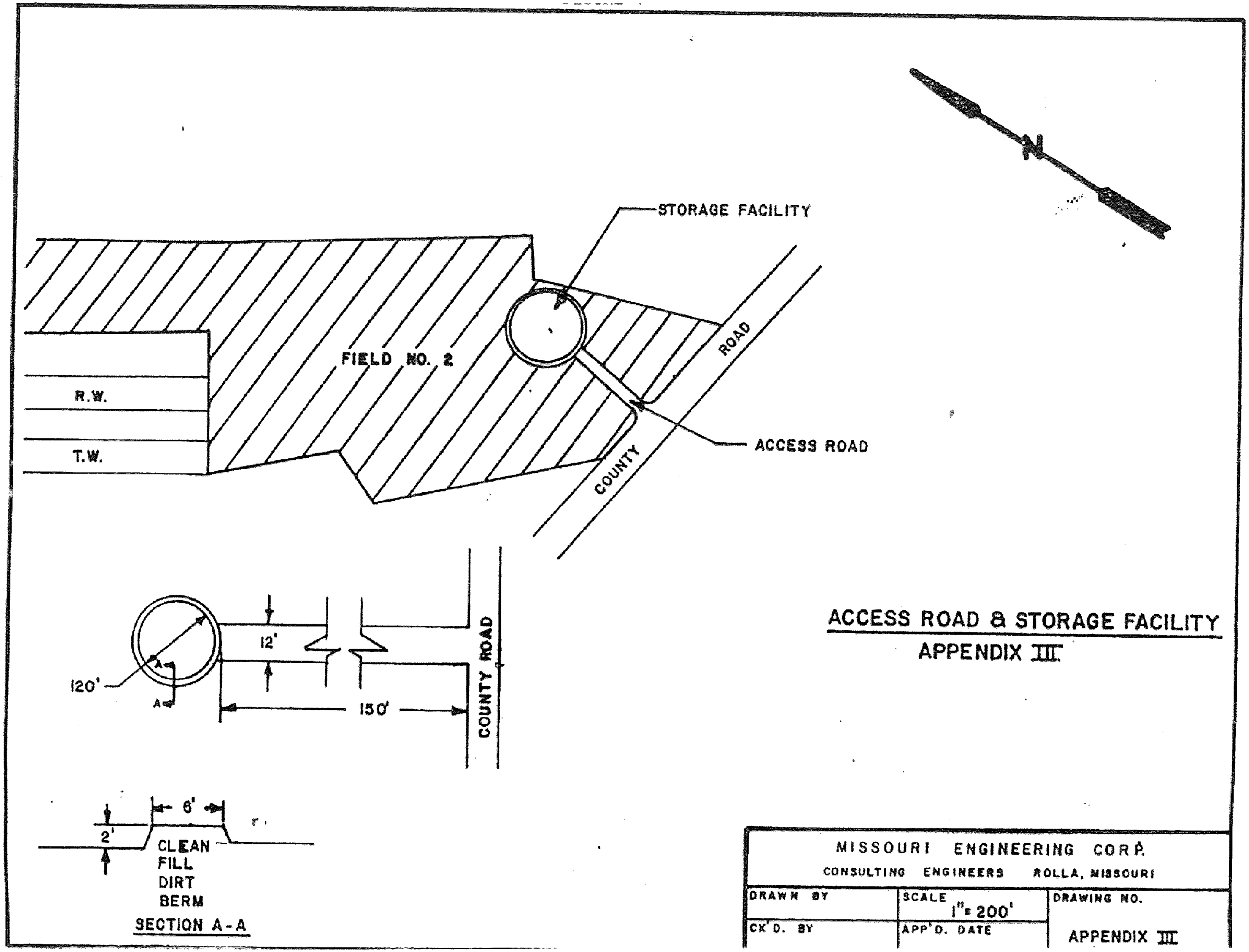
Valerie Wilder, Chief, Superfund Section

Date: 3-11-19

APPENDIX A

FIGURES

Figure 3: Sludge Disposal Area Diagram from 1999 PA/SI



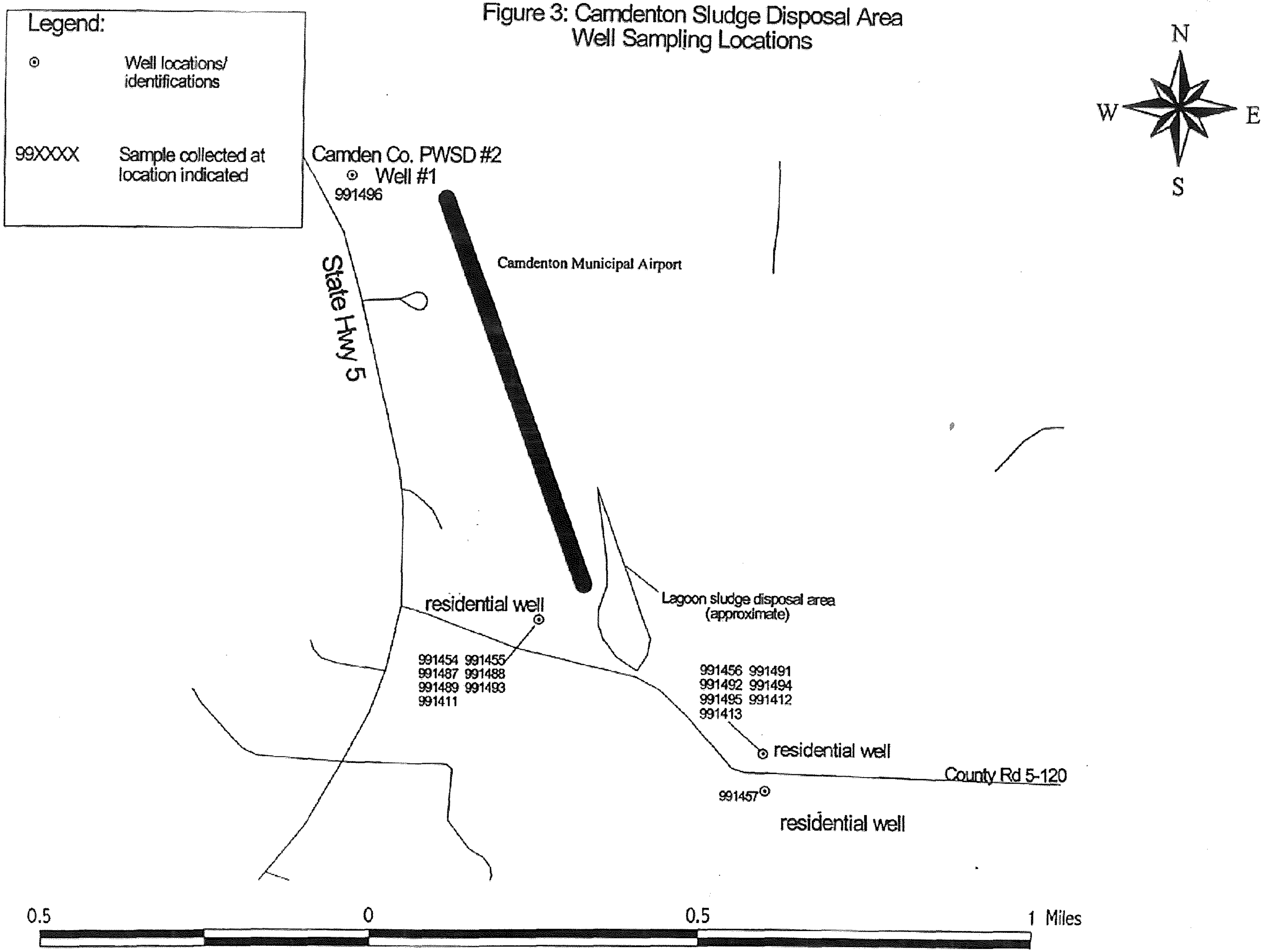


Figure 3: Camdenton Sludge Disposal Area Well Sampling Locations

Figure 5. 1999 Camdenton Sludge Disposal Area PA SI Soil Sample Location Map

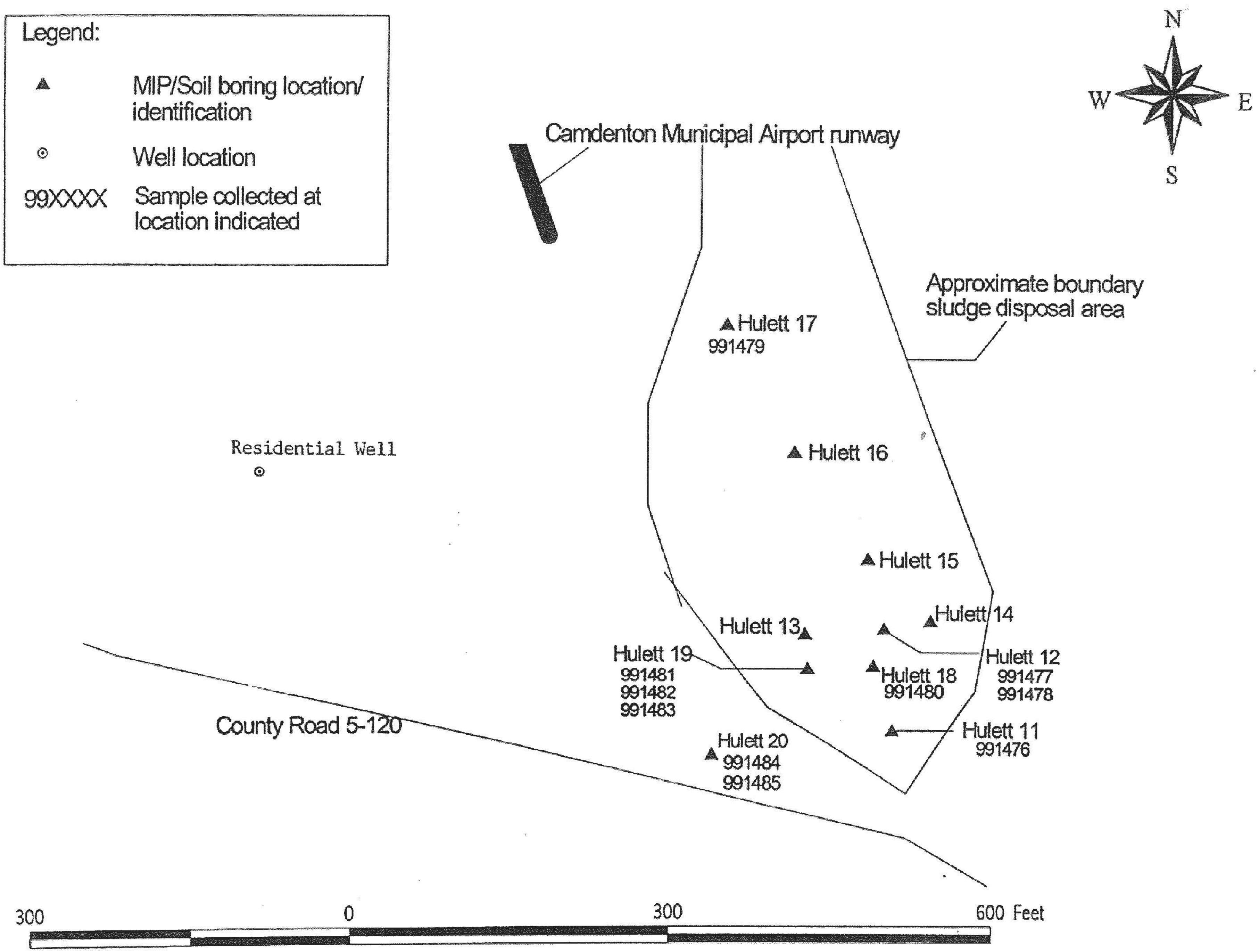


Figure 6 : Sludge Disposal Area Diagram close up from 199 PA/ SI

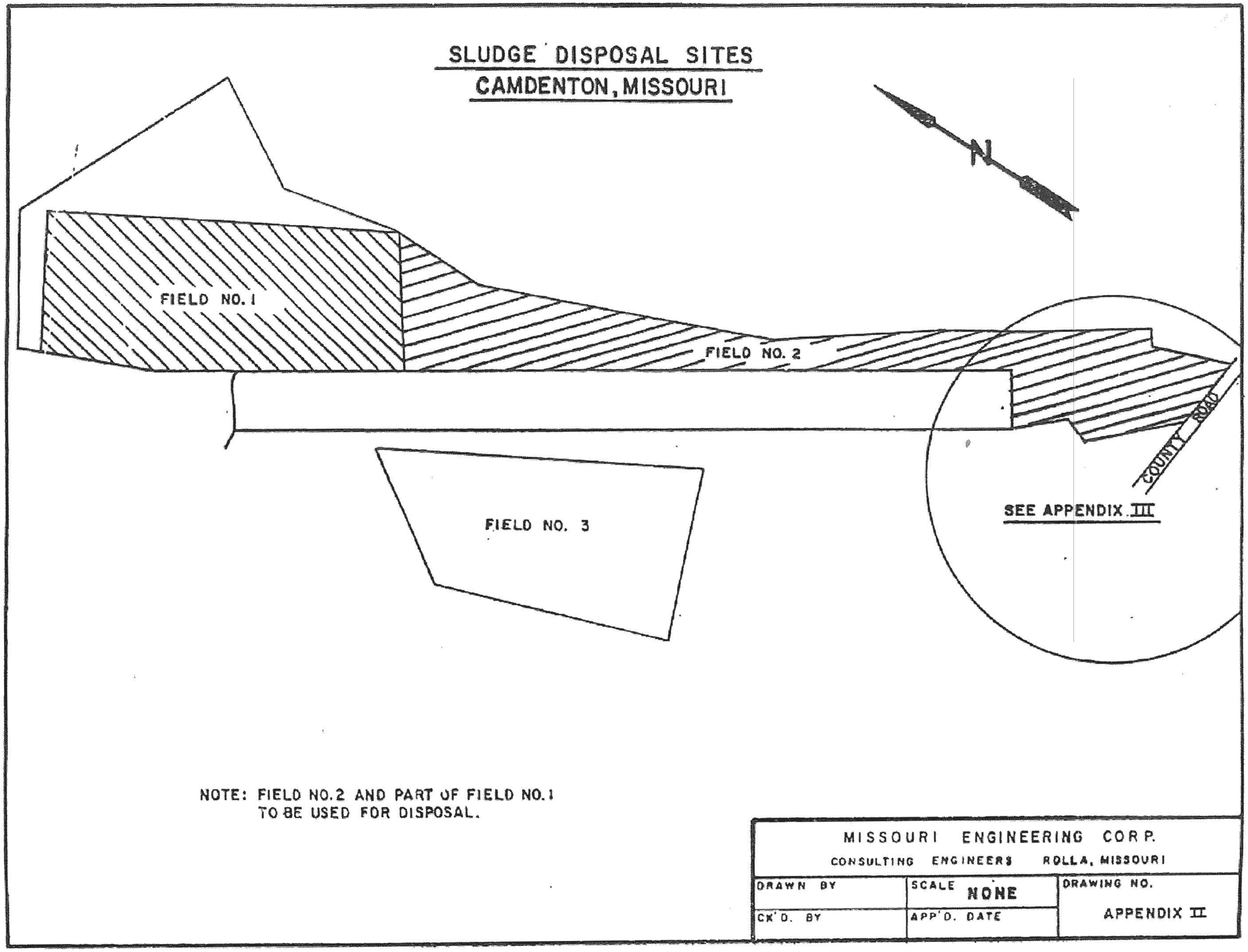


Figure 8 : Missouri Geological Survey Structures of Camden County Map from 1999 PA/SI

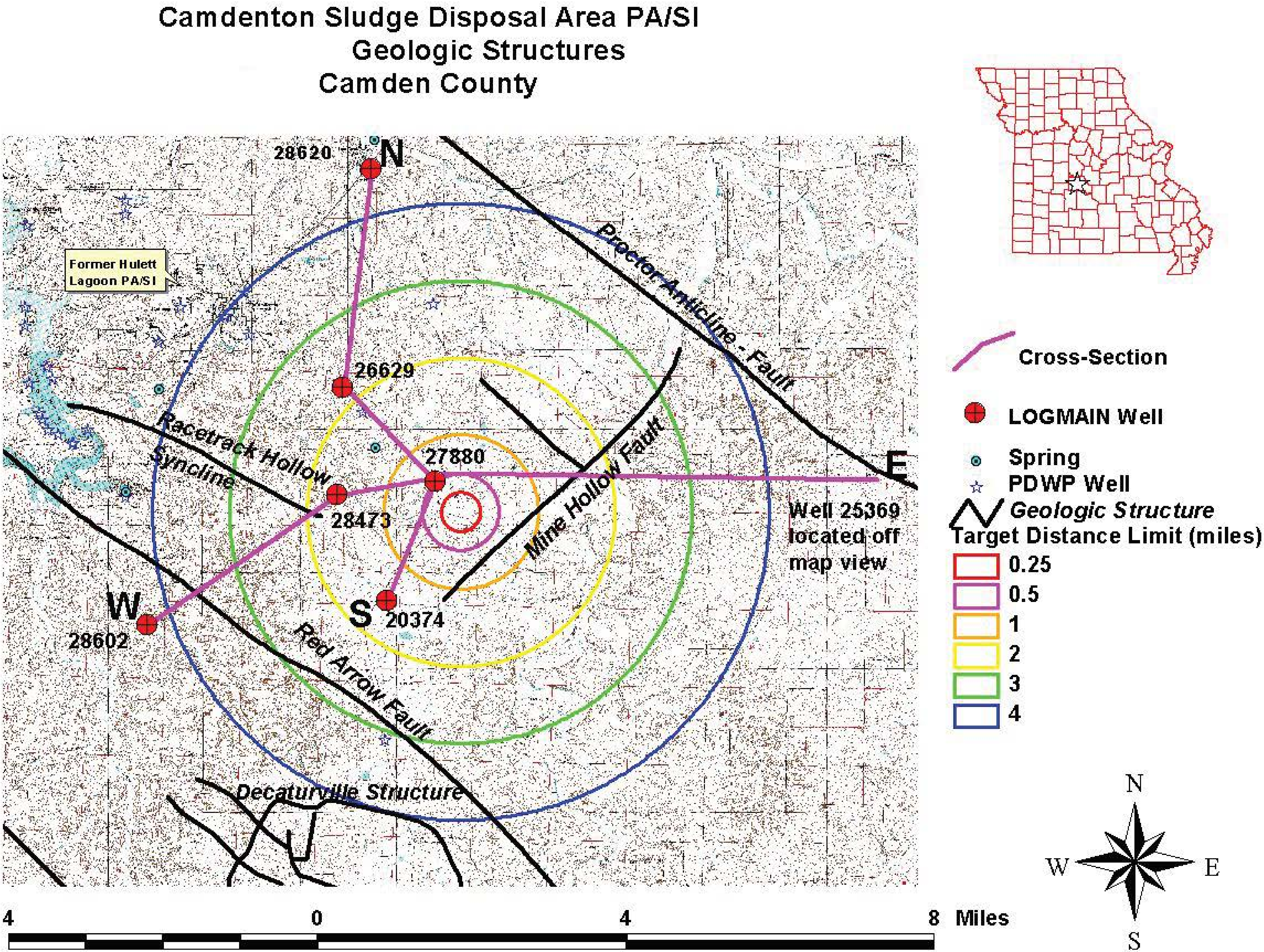
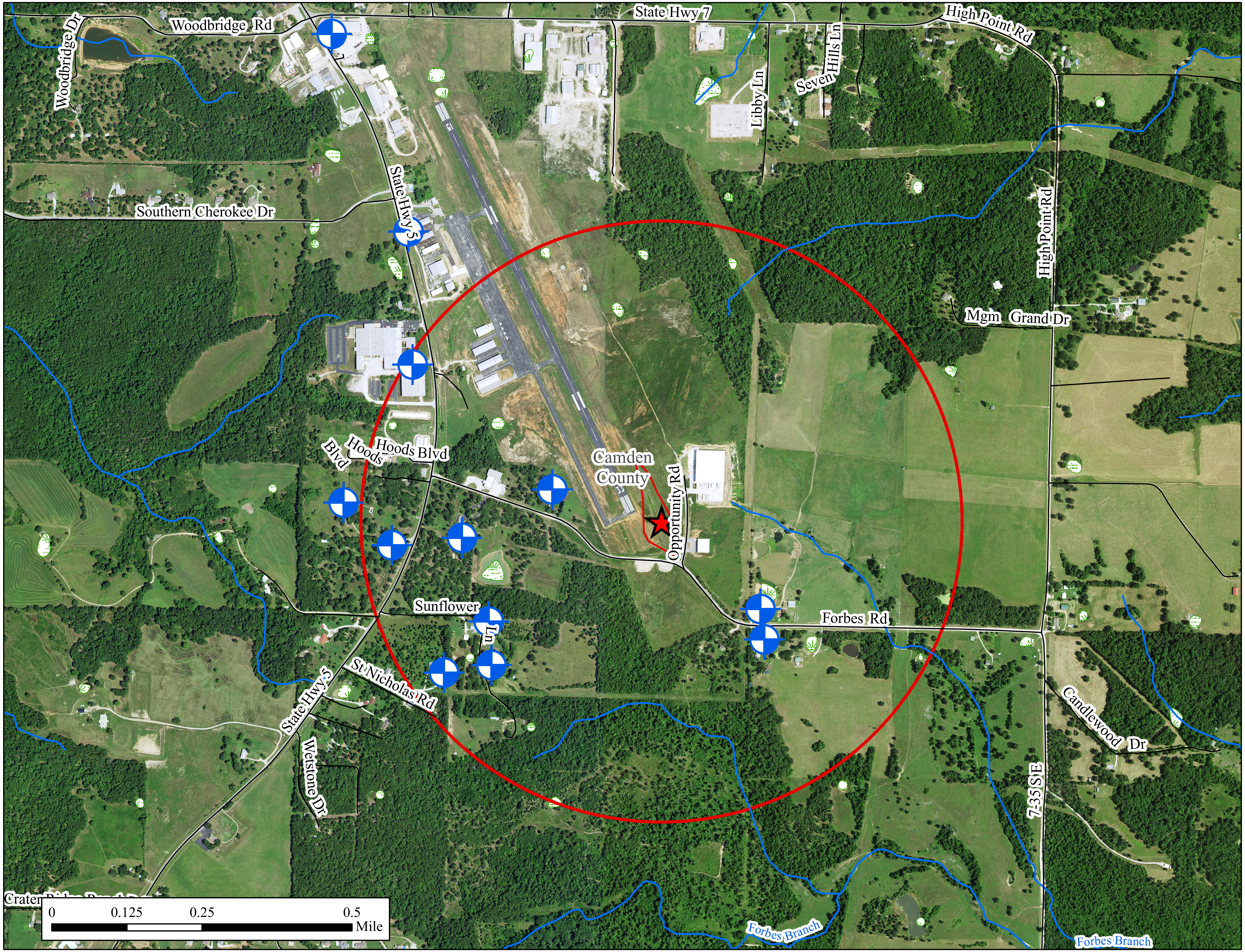
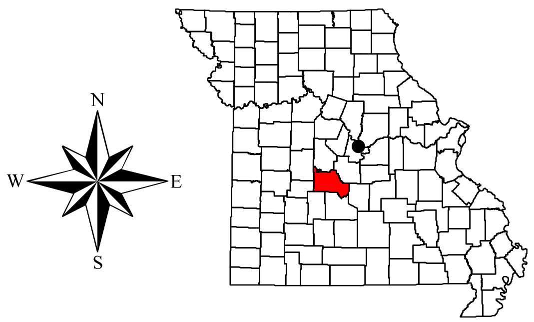


Figure 10:
Site Reassessment Groundwater Sampling Location Map
October, 2017
Camdenton Sludge Disposal Area Site
Camden County, Missouri



Legend

- Sludge Disposal Area Site
- Sampled Well
- Half Mile Radius
- National Wetland Inventory
- Sludge Field Outline
- US Census Bureau Roads
- Rivers and Streams

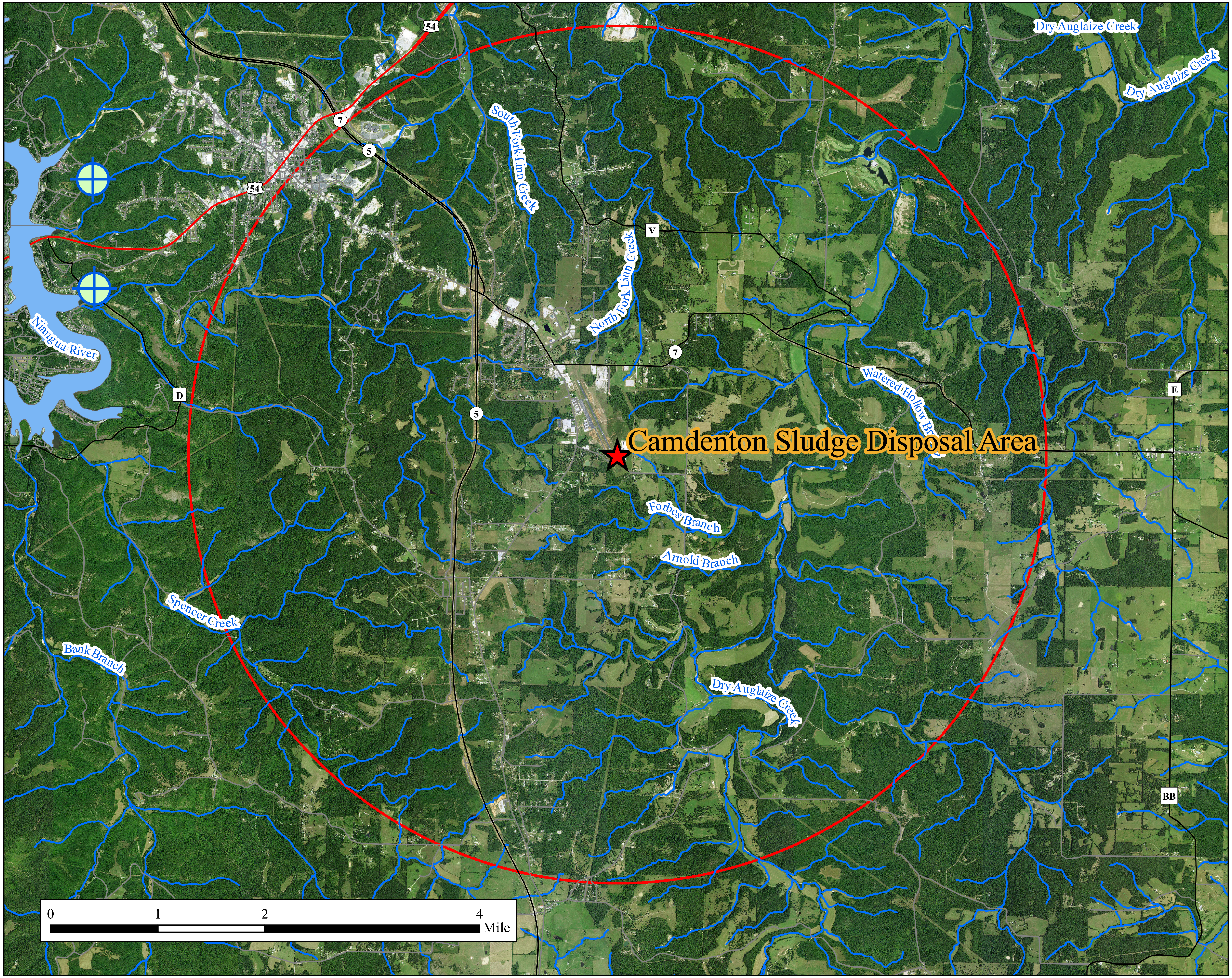


Created on: 1-05-18 by Keith Brown. This map is located at M/Superfund/Camdenton Sludge Disposal Site

Base Map: National Agriculture Imagery Program (NAIP) ortho photography. Flight Date: 2014
Data Sources: US Census 2010;
Missouri Department of Transportation

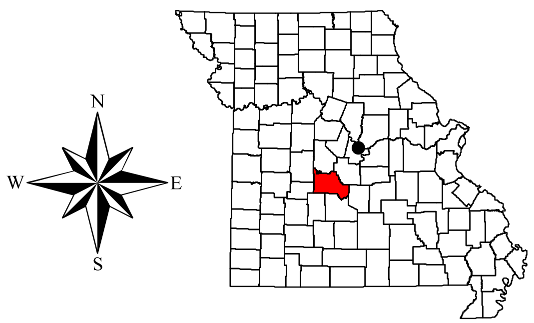
MISSOURI DEPARTMENT OF NATURAL RESOURCES

Figure 11: Site Reassessment Background Groundwater Wells Sampled Map October 19, 2017 Camdenton Sludge Disposal Area Site Camden County, Missouri



Legend

- Sludge Dispoal Area
- Background Wells Sampled
- Local Roads
- Federal Highway
- State Lettered Highway
- State Numbered Highway
- Rivers and Streams
- Lake of the Ozarks
- 4 Mile Site Radius



Created on: 5-24-17 by Keith Brown. This map is located at M/Superfund/Camdenton Sludge Disposal Site

Base Map: National Agriculture Imagery Program (NAIP) ortho photography. Flight Date: 2014
Data Sources: US Census 2010;
Missouri Department of Transportation

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

APPENDIX B

TABLES

TABLE 1: SELECTED ANALYTICAL RESULTS FROM SOIL SAMPLES COLLECTED BY DAMES & MOORE IN CITY LAGOON # 3 ON OCTOBER 11, 1996			
Sample ID	**Depth**	**Analyte Detected**	**Concentration (in ppm)**
GP-1	4' - 6'	chloroform	0.20
		TCE	9.17
GP-2	4' - 5.5'	TCE	1.94
GP-3	4' - 5'	chloroform	0.0094
		cis-1,2-dichloroethene	0.0914
		TCE	not detected
GP-4	4' - 6'	TCE	not detected

TABLE 2: ANALYTICAL RESULTS FROM SOIL SAMPLES COLLECTED JANUARY 21, 1999 IN/NEAR THE CITY LAGOON #3

All results in parts per million (ppm) * soil saturation level substituted for ASL NA - not analyzed NL - not listed
Underlined results are those that are three times above background or above the detection limit if the background concentration is below the detection limit

	Hulett-01	Hulett-02	Hulett-03		Hulett-04	Hulett-07	Hulett-09		Hulett-10	SCDM		MO	MO
	4.5' - 5'	6.5' - 7'	3' - 4'	4.5' - 5.5'	7.5' - 8'	5.5' - 6'	6' - 7'		10.5' - 11'	Ref Dose	Canc. Scrn Conc.	ASL	CALM C_{LEACH}
	991469	991470	991467	991468	991471	991472	991473	991474 (replicate)	991475 (background)				
METALS													
Arsenic, total	16.1	3.58	13.6	12.5	19.7	17.2	9.68	4.6	10.7	23	0.43	11	NL
Barium, total	150	62.4	244	519	750	257	103	132	203	5500	NL	3900	1650
Barium, TCLP	NA	NA	NA	0.442	0.628	NA	NA	NA	NA				
Cadmium, total	0.453	0.254	0.304	0.386	4.52	0.304	<0.2	0.204	0.651	39	NL	28	11
Chromium, total	74.9	31.9	55.5	61.3	68.9	73.3	58.2	39.8	62.7	390	NL	5600	38
Copper, total	39.9	15.7	33.6	37.5	64.3	38.8	6.47	8.56	36.8	NL	NL	NL	NL
Lead, total	116	38.1	118	951	325	80.1	39.1	61.8	94.2	NL	NL	240	NL
Lead, TCLP	<0.025	NA	0.0772	0.143	<0.025	<0.025	NA	NA	<0.025				NL
Mercury, total	0.102	<0.04	0.107	0.139	0.195	0.141	<0.04	<0.04	0.0947	23	NL	17	3.23
Nickel, total	43.3	12.5	49.4	69.6	90.1	36.2	9.76	12.4	32.5	1600	NL	1100	170
Selenium, total	<1	<1	<1	<1	<1	<1	<1	<1	<1	390	NL	280	4.37
Silver, total	<1	<1	<1	<1	<1	<1	<1	<1	<1	390	NL	280	255
VOCs													
Cis-1,2-dichloroethene	0.19	0.14	<0.025	<0.025	<0.025	0.11	<0.025	<0.025	<0.025	780	NL	490*	0.51
Trichloroethene	9.5	0.24	<0.025	<0.025	<0.025	0.12	<0.025	<0.025	<0.025	NL	58	340	0.097

TABLE 3: SELECTED ANALYTICAL RESULTS FROM SOIL SAMPLES COLLECTED IN/NEAR THE CAMDENDTON SLUDGE DISPOSAL AREA 1999 PA/SI													
All results in parts per million (ppm) * soil saturation level substituted for ASL NA - not analyzed NL - not listed Underlined results are those that are three times above background or above the detection limit if the background concentration is below the detection limit Bolded results are those that are above background and exceed SCDM Benchmark and/or MO ASL													
	Hulett-11	**Hulett-12**		**Hulett-17**	**Hulett-18**	**Hulett-19**			**Hulett-20**		**SCDM Benchmark**	**MO ASL**	**MO CALM CLEACH**
	0.5' – 1'	**0.5' – 1'**	**8.5' – 9'**	**0.5' – 1.5'**	**5.5' – 6'**	**0.5' – 1'**	**7' – 7.5'**	**7' – 7.5'**	**0.5' – 1'**	**5.5' – 6'**			
	991476 stockpile	**991478 sludge**	**991477**	**991479**	**991480**	**991483 sludge**	**991481**	**991482 replicate**	**991484**	**991485**			
									Background				
METALS													
Arsenic, total	7.46	8.78	4.98	5.97	7.08	19.7	4.94	5.76	8.74	34	0.0043	11	NL
Barium, total	170	280	139	105	93.7	253	69	82.6	206	195	5500	3900	1650
Cadmium, total	<0.2	0.782	<0.2	<0.2	0.216	1.55	<0.2	<0.2	<0.2	0.409	39	28	11
Chromium, total	33.1	**1640**	27.5	34.7	74.8	**7830**	38.8	43.9	38.1	110	390	5600	38
Chromium, TCLP	NA	0.0463	NA	NA	NA	0.041	NA	NA	NA	<0.004			
Copper, total	9.45	1890	10.4	6.79	7.12	11200	8.67	11.4	14.6	32	NL	NL	NL
Lead, total	21.8	66.2	19.2	17.3	19.4	121	13.5	16.6	26.3	67.6	NL	240	NL
Lead, TCLP	NA	NA	NA	NA	NA	<0.0411	NA	NA	NA	NA			
Mercury, total	<0.04	0.314	<0.04	<0.04	<0.04	0.195	<0.04	<0.04	0.0819	<0.04	23	17	3.23
Nickel, total	12.3	29.9	15.5	11.4	9.33	129	8.4	9.4	15.5	42.7	1600	1100	170
Selenium, total	<1	<1	<1	<1	<1	1.03	<1	<1	<1	<1	390	280	4.37
Silver, total	<1	<1	<1	<1	<1	3.17	<1	<1	<1	<1	390	280	255
VOCs													
Ethylbenzene	<0.025	<0.025	<0.025	<0.025	<0.025	0.023	<0.025	0.018	<0.025	<0.025	58	340	0.097
Toluene	<0.025	<0.025	<0.025	<0.025	<0.025	0.03	<0.025	<0.025	<0.025	<0.025	58	340	0.097
Total Xylenes	<0.025	<0.025	<0.025	<0.025	<0.025	0.084	<0.025	<0.025	<0.025	<0.025	58	340	0.097

Table 4: Stratigraphic Column for the Camdenton Sludge Disposal Area, Camden County

System	Aquifer Group	Approximate Site – Specific Thickness (ft.)	Formation	Hydraulic Conductivity (cm/sec)	Regional Thickness (ft.)	Dominant Lithology	Water-bearing Character
Quaternary		10	Colluvium and residuum		0-90	Regolith of residual clay, sand, chert pebbles and cobbles	May contain small amounts of perched water.
Ordovician	Ozark Aquifer	50	Roubidoux Formation	10^{-3}	0-90	Clayey residuum, sandstone and sandy dolomite	Not present in sufficient thickness in the Camdenton area to produce usable quantities of water.
		280	Gasconade Dolomite	10^{-6}	300-385	Cherty dolomite, minor sandstone, and shale	Yields moderate to large quantities of water to wells. Yields range from 20 to 75 gpm. Less-permeable Upper Gasconade may act as a leaky confining unit.
		25	Gunter Sandstone Member	10^{-4}	10-45	Sandstone	Contributes moderate to large quantities of water. Most wells open to other formations.
Cambrian		550?	Eminence Dolomite	10^{-5}	240-635	Cherty dolomite	Yields 6-100 gpm, the average being about 20 gpm
		50?	Potosi Dolomite	10^{-4}	30-330	Dolomite; contains abundant quartz druse	Yields large quantities of water to wells. Yields range from 100 to 750 gpm.
	St. Francois Confining Unit	80	Derby-Doerun Dolomite	10^{-7}	80?-215	Shaley dolomites and shale	Reliable aquitard.
		80	Davis Formation	10^{-7}	50-380?		
	St. Francois Aquifer	90	Bonneterre Formation	10^{-5}	85-200	Dolomite and limestone	Generally used only in outcrop areas. May contribute additional 100-200 gpm to wells open to other formations.
		300	Lamotte Sandstone	10^{-5}	140-300	Sandstone and arkosic conglomerate	
Precambrian	Basement Confining Unit					Igneous and metamorphic rocks	Does not yield water to wells in this area

TABLE 5: DRINKING WATER WELLS REGISTERED WITH THE DEPARTMENT WITHIN A 4-MILE RADIUS OF THE CAMDENTON SLUDGE DISPOSAL AREA SITE			
Miles From Site	Number of Public Wells	Number of Private Wells	Estimated Population Served
0 – 1/4	0	1	2
1/4 – 1/2	0	5	10
1/2 - 1	3	17	600
1-2	2	46	993
2-3	4	104	453
3-4	6	99	3257
TOTAL	**16**	**272**	**5315**

TABLE 6: SELECTED ANALYTICAL RESULTS FOR DRINKING WATER WELL SAMPLES COLLECTED OCTOBER 2, 2017
CAMDENTON SLUDGE DISPOSAL AREA SITE, CAMDEN COUNTY, MISSOURI

- All values listed in parts per billion (ug/l) unless otherwise noted.
- NL denotes benchmark value not listed in reference source.
- Sample results in bold exceed three times background values
- Sample results in shaded cells exceed the lowest of the SCDM benchmark or action level values

Laboratory Number	**AD08851**	**AD08852**	**AD08853**	**AD08854**	**AD08855**	**AD08856**	**AD08857**	**AD08858**	**AD08859**	**AD08860**	**AD08861**	**AD08862**	**AD08863**	**AD09231**	**SCDM[1]**	**EPA RML[2]**	**EPA SL[3]**	**MO WQS[4]**
Sample Comments	**private well**	**private well**	**private well**	**private well**	**private well**	**public well**	**private well**	**private well**	**private well**	**private well**	**private well**	**private well**	**private well**	**background well***				
Location ID	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**109 Dup**	**110**	**111**	**112**	**118**				
Water Quality Indicators																		
Field Temperature °C	16.7	17.7	18.4	16.8	16	16.5	15.6	16.1	16.1	NA	16	16.3	17.6	15.5	NL	NL	NL	NL
pH	7.56	7.64	7.59	7.52	7.56	7.6	7.43	7.6	7.65	NA	7.47	7.58	7.78	7.09	NL	NL	NL	NL
Specific Conductivity, umhos/cm	535	473	496	475	445	456	452	420	525	NA	544	475	507	703	NL	NL	NL	NL
Metals																		
Barium, dissolved	53	45.2	45.2	46.8	36.3	49	42.4	39.9	81.4	81.4	59.1	43.1	47.6	52.2	2000	1100	3800	2000
Barium	56.7	46.6	46.7	47.5	38.1	48.8	42.5	40.6	82.1	83.2	60	44.7	47.5	51	2000	1100	3800	2000
Chromium, dissolved	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	100	NL	NL	100
Chromium, total EPA method 200.7	<1.25	<1.25	<1.25	<1.25	<1.25	**3.25**	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	100	NL	NL	100
Copper, dissolved	1.18	2.17	7.35	<1	1.89	3.19	3.39	1.4	1.31	1.26	1.13	4.44	2.53	3.07	1300	2400	800	1300
Copper	**82.1**	2.4	**9.11**	<1.25	2.13	3.14	4.19	1.63	1.54	1.72	1.39	**13.1**	6.7	2.49	1300	2400	800	1300
Lead, dissolved	<1	<1	<1	<1	<1	**1.76**	<1	<1	<1	<1	<1	**4.89**	<1	<1	15	15	15	15
Lead	**6.95**	<1.25	<1.25	<1.25	<1.25	**4.75**	<1.25	<1.25	<1.25	<1.25	<1.25	**63.6**	<1.25	<1.25	15	15	15	15
Zinc, dissolved	**29**	**16.4**	**402**	**104**	**12.7**	**238**	**45.6**	6.66	**57.8**	**57.8**	9.14	**22.9**	**132**	3.36	NL	1800	6000	5000
Zinc	**51.6**	**13.6**	**384**	**92**	**9.58**	**225**	**38.1**	4.74	**49.9**	**49.5**	7.82	**20.4**	**109**	3.14	NL	1800	6000	5000
Volatile Organic Compounds (VOCs)																		
Trichloroethylene (TCE)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5	2.8	0.49	5

[1] SCDM - Superfund Chemical Data Matrix, Maximum Contaminant Level (MCL) for drinking water, November, 2017. Risk level 10^{-6}, hazard quotient =1.

[2] EPA RML - Removal Management Level November, 2017. Lower of cancer and non-cancer values. Risk level 10^{-4}, hazard quotient=1

[3] EPA SL - EPA Regional Screening Levels tap water, November 2017. Lowest of carcinogenic and non-carcinogenic value. Risk level 10-6, hazard quotient =1.

[4] MO WQS - Missouri Water Quality Standards, groundwater/drinking water use catagories, Missouri Code of State Regulations, 10 CSR 20-7.031, June, 2015.

* Background well was sampled on 10-19-2017

TABLE 7: SELECTED ANALYTICAL RESULTS FOR DRINKING WATER WELL SAMPLES COLLECTED OCTOBER 19, 2017
CAMDENTON SLUDGE DISPOSAL AREA, CAMDEN COUNTY, MISSOURI

- All values listed in parts per billion (ug/l) unless otherwise noted.
- NL denotes benchmark value not listed in reference source.
- NA denotes not analyzed
- Sample results in shaded cells exceed the lowest of the SCDM benchmark or Action Level values
- Sample results in bold exceed three times background values

Sample Laboratory Number	AD09226	AD09232	AD09224	AD09229	AD09233	AD09225	AD09234	AD09235	AD09227	AD09228	AD09220	AD09221	AD09223	AD09231	AD09230	AD15268	AD15267	SCDM[1]	EPA RML[2]	EPA SL[3]	MO WQS[4]
Location ID	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111(F)***	**111**	**112**	**118**	**123**	**123**	**123**				
Sample comments	**Private well**	**Private well**	**Private well**	**Private well**	**Private well**	**Public well**	**Private well**	**Private well**	**Private well**	**Private well**	**Private well**	**Private well**	**Private well**	**Background well**	**Background well**	**pitcher filter****	**refrigerator filter****				
Water Quality Indicators																					
Field Temperature, °C	15.4	17	16.7	16.1	15.2	15.7	15.2	15.1	14.8	15	16.7	14.6	14.7	15.5	15.6	15.6	13.7	NL	NL	NL	NL
pH	7.42	7.56	7.55	7.48	7.45	7.53	7.36	7.52	7.5	7.49	7.24	7.16	7.29	7.09	7.43	7.43	7.46	NL	NL	NL	NL
Specific Conductivity, umhos/cm	506.3	427.8	455.4	462.1	460.1	454	438.6	413.9	514.6	534.5	469.1	461.5	449.3	703	575	575	560	NL	NL	NL	NL
Metals																					
Barium, dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	44.9	NA	52.2	56.8	NA	NA	2000	11000	3800	2000
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.25	44.3	NA	51	54.6	NA	NA	2000	11000	3800	2000
Chromium, hexavalent	NA	NA	NA	NA	NA	.31 (d)	NA	NA	NA	NA	NA	NA	NA	.013 (d)	.081 (d)	NA	NA	NL	3.5	0.035	NL
Chromium, EPA method 200.8	1.73 (k)	1.59 (k)	1.37 (k)	1.53 (k)	1.58 (k)	1.77 (k)	3.99 (k)	1.75 (k)	1.39 (k)	1.64 (k)	1.33 (k)	1.82 (k)	1.42 (k)	2.42 (k)	1.47 (k)	NA	NA	100	NL	NL	100
Chromium, EPA method 200.7	<1.25	<1.25	<1.25	<1.25	<1.25	**4.41**	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	<1.25	NA	NA	100	NL	NL	100
Copper, dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.4	3.67	NA	3.07	1.19	NA	NA	1300	2400	800	1300
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.26	12.9	NA	2.49	1.58	NA	NA	1300	2400	800	1300
Lead, dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	3.44	NA	<1	22.5	NA	NA	15	15	15	15
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.25	28.8	NA	<1.25	23.7	10.7	<0.5	15	15	15	15
Zinc, dissolved	**25.7**	**15.4**	**334**	**56.1**	10.3	**218**	**22.9**	**10.9**	**51.6**	5.4	4.08	**16.2**	**160**	3.36	29.3	NA	NA	NL	18000	6000	5000
Zinc	**20**	**17.2**	**342**	**53.5**	**9.6**	**342**	**29.3**	**10.6**	**52.8**	**5.4**	1.7	**22**	**161**	3.14	29.8	NA	NA	NL	18000	6000	5000

[1] SCDM - Superfund Chemical Data Matrix, Maximum Contaminant Level (MCL) for drinking water, November, 2017. Risk level 10^{-6}, hazard quotient =1.

[2] EPA RML - Removal Management Level, 2014. Lower of cancer and non-cancer values. Risk level 10^{-4}, hazard quotient=1

[3] EPA SL - EPA Regional Screening Levels tap water, November 2017. Lowest of carcinogenic and non-carcinogenic value. Risk level 10-6, hazard quotient =1.

[4] MO WQS - Missouri Water Quality Standards, groundwater/drinking water use catagories, Missouri Code of State Regulations, 10 CSR 20-7.031, June, 2015.

d - Analyzed by Contract Laboratory

k - Estimated value, matrix interference

* Location 111F denotes a sample collected from an indoor faucet at location 111

** Samples collected on 2-13-18 and analyzed by EPA SW 846 6020 to assess lead risk after filtration

TABLE 8: CALCULATION OF SAMPLE/SAMPLE DUPLICATE RELATIVE PERCENT DIFFERENCE (RPD) GROUNDWATER SAMPLES COLLECTED OCTOBER 2, 2017 CAMDENTON SLUDGE DISPOSAL AREA SITE, CAMDEN COUNTY, MISSOURI

All results are in (mg/kg ug/l) unless otherwise noted

Sample ID	**173389**	**173390**	**RPD**
Laboratory Number	**AD08859**	**AD08860**	
Metals			
Arsenic, dissolved	<1	<1	NA
Arsenic - Total	<1.25	<1.25	NA
Barium, dissolved	81.4	81.4	0.0
Barium	82.1	83.2	0.7
Chromium, dissolved	<1	<1	NA
Chromium, total	<1.25	<1.25	NA
Copper, dissolved	1.31	1.26	1.9
Copper	1.54	1.72	5.5
Lead, dissolved	<1	<1	NA
Lead	<1.25	<1.25	NA
Zinc, dissolved	57.8	57.8	0.0
Zinc	49.9	49.5	0.4
Volatile Organic Compounds (VOCs)			
Trichloroethylene (TCE)	<0.5	<0.5	NA

TABLE 9: ESTIMATED POPULATION WITHIN A 4-MILE RADIUS OF THE SITE

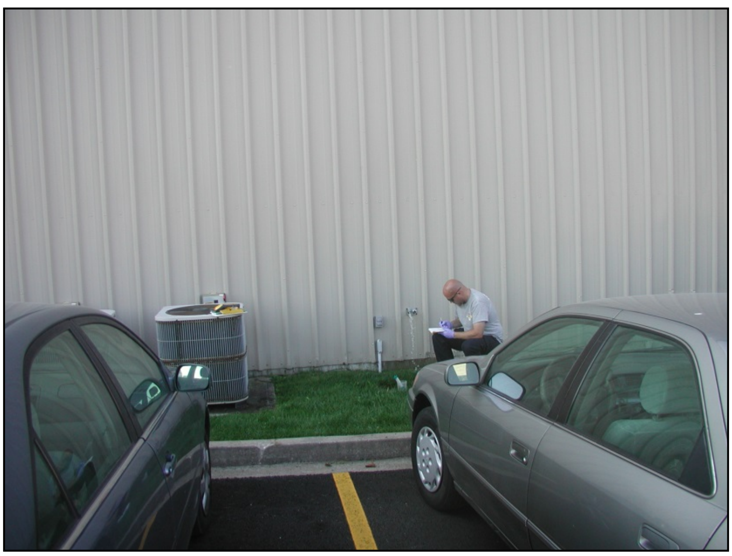
RADIUS	POPULATION
ON-SITE	0
0 - 1/4	3
1/4 - 1/2	23
1/2 - 1	122
1 - 2	579
2 - 3	587
3 - 4	1,242
TOTAL	2,556

APPENDIX C

PHOTOGRAPHIC LOG

Photograph 1
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well spigot at Location 101 during sampling. Photo taken facing north.



Photograph 2
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

View of well spigot at Location 102 during 5 minute purge prior to sampling. Photo taken facing south.

Photograph 3
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of Location 103 during sampling. Photo taken facing south.

Photograph 4
Camdenton Sludge Disposal Area Site
Camdenton , Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well Spigot (with hose attached) for location 104. Photograph was taken facing north.

Photograph 5
Camdenton Sludge Disposal Area Site
Camdenton , Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Picture depicts sampling preparations for well spigot at location 105. Photograph was taken facing east.

Photograph 6
Camdenton Sludge Disposal Area Site
Camdenton , Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of pump station for Camden County PWSD #2 Well #1 (Location 106-Airport Well).

Photograph 7
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

View of Camden County PWSD #2 Well #2 (Location 106) pump house. Photograph was taken facing west.

Photograph 8
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of well pump house at Location 107. Photograph was taken facing south.

Photograph 9
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well cap at Location 108. Well stem and portable GPS unit are in the foreground. Photograph was taken facing south.

Photograph 10
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of Location 109 during sampling. Well shaft is within stone structure near propane tanks. Photograph was taken facing east.

Photograph 11
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of house at Location 110. Photograph was taken facing south.

Photograph 12
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of pump house at Location 111. Well casing and pump are enclosed in the portion of the building with the door ajar. Photograph was taken facing south.

Photograph 13
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/02/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph well spigot where sample was collected at Location 112. Photograph was taken facing south.

Photograph 14
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of ESP staff resampling the well at Location 111. Photograph was taken facing south.

Photograph 15
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of ESP well head and water tank at Location 111 during resampling.

Photograph 16
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of well spigot at Location 111 during resampling. Photograph was taken facing south.

Photograph 17
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of ESP staff monitoring parameters from the well spigot at Location 103 during resampling. Photograph was taken facing south.

Photograph 18
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph depicts ESP staff collecting water quality parameters prior to resampling of Camden County Public Water Supply District #2 Well #1 (Location 106). Photograph was taken facing north.

Photograph 19
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

View of ESP conducting resampling of well at Location 101. Photograph was taken facing east.

Photograph 20
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph depicts ESP staff conducting resampling of well at Location 109. Photograph was taken facing east.

Photograph 21
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture shows ESP staff accessing well spigot (attached to outer wall of home) for resampling at Location 110. Photograph was taken facing south.

Photograph 22
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well spigot at Location 104 during resampling. Hose was connected during purging and was disconnected prior to actual sampling. Photograph was taken facing north.

Photograph 23
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture of well spigot at Location 123 during initial round of sampling. Photograph was taken facing west.

Photograph 24
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well spigot at Location 118 during initial round of sampling. Photograph was taken facing west.

Camdenton Sludge Disposal Area
Site Reassessment Photographic Log

Photograph 25
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture shows an up close view of the well spigot at Location 102 during resampling. Photograph was taken facing south.

Photograph 26
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Photograph of well spigot at Location 105 during resampling. Hose was attached during purging and was disconnected prior to actual sampling. Photograph was taken facing north.

Photograph 27
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2018 by
Keith Brown,
DEQ, HWP, SF

Well housing for location 107 is depicted in the foreground of photograph. ESP staff are conducting resampling in the background.

Photograph 28
Camdenton Sludge Disposal Area Site
Camdenton, Camden County, MO
Photo taken 10/19/2017 by
Keith Brown,
DEQ, HWP, SF

Picture shows an up close view of the well spigot at Location 108 during resampling. Well spigot is turned on for purging until water quality parameters stabilize in this photograph. Photograph was taken from back porch of home

APPENDIX D

SAMPLING DOCUMENTATION

Site Reassessment Sampling Report

Camdenton Sludge Disposal Area Site

Camdenton, Missouri

Camden County

October 2nd and 19th, 2017

February 13, 2018

Prepared For:

Missouri Department of Natural Resources
Division of Environmental Quality
Hazardous Waste Program

Prepared By:
Missouri Department of Natural Resources
Division of Environmental Quality
Environmental Services Program

<u>**Table of Contents**</u>

1.0 Introduction

As authorized under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986, the Missouri Department of Natural Resources (MoDNR), Hazardous Waste Program (HWP), Site Assessment Unit (SAU) and MoDNR, Environmental Services Program (ESP), Field Services Unit (FSU) conducted a Site Reassessment (SR) at the Camdenton Sludge Disposal Area site. The Camdenton Sludge Disposal Area is the location of a disposal site for municipal sewage sludge that contained industrial effluent and is suspected to contain contaminants that could be released into the environment.

The objective of this investigation was to re-assess potential threats to human health and the environment at the site. The investigation included collection of groundwater samples from private and public drinking water wells in the vicinity of the former Camdenton Sludge Disposal Area at the Camdenton Municipal Airport.

2.0 Site Information

2.1 Location

The Camdenton Sludge Disposal Area site is located on Old South 5 in the southeast portion of the Camdenton Memorial Airport property. The site is located on city property, but is actually three miles southeast of Camdenton city limits (appendix A). Geographic coordinates for the site are 37°58'08.7" and 92°41'14.7". The sludge disposal area has been previously identified at the south east side of the airport and a portion of the original area has since been covered by pavement during an expansion of the runway. The site is approximately four miles from three other sites in Camdenton with known soil and groundwater Trichloroethylene (TCE) contamination; Hulett Lagoon (where the sludge originated), former Modine Manufacturing facility, and the City of Camdenton's Mulberry Well.

2.2 Operational and Site History

The site is a municipal airport for the City of Camdenton. The full name of the airport is the Camdenton Memorial –Lake Regional Airport- KOZS. Regional flights serve the Lake of the Ozarks regional area. In 1989 the City of Camdenton land applied sewage sludge from Hulett Lagoon which received industrial effluent from a metal parts manufacturing facility. The waters and sludge from Hulett Lagoon have been found to contain VOCs and metals. The sludge was applied to an area at the south end of the airport south and east of the runway.

2.3 Previous Investigations

The department's Superfund site assessment unit completed a Combined Preliminary Assessment/Site Inspection (PA/SI) Report on the Camdenton Sludge Disposal Area site on March 30, 1999. Soil borings were collected in the sludge disposal area of the airport. Total chromium, copper, lead and nickel were detected above background concentrations in the soil borings collected within the sludge material, but no TCE was detected in any of the soil cores. Only total chromium level exceeded the Superfund Chemical Data matrix (SCDM) benchmarks. No hexavalent chromium analysis was conducted. None of the soil samples were characterized as characteristically hazardous waste using the Toxicity Characteristic Leaching Procedure (TCLP). Ethylbenzene, toluene, and total xylenes were detected in soil cores at concentrations above background levels, but below health based benchmarks.

Groundwater samples were also collected from private and public drinking water wells in the area. Although there was an initial positive detection of TCE in a pair of groundwater samples from two private wells near the disposal site, repeated sampling efforts were unable to duplicate these results and it was determined that there was no significant threat from TCE in the groundwater at that time.

3.0 Data Quality Objectives

To help ensure precise, accurate, representative, complete, and comparable data, all field work and analyses was conducted in accordance with the Quality Assurance Project Plan (QAPP) for Pre-Remedial/Pre-Removal and Targeted Brownfields Site Assessments Revision 7, December 7, 2012, and ongoing. The QAPP describes the general data quality objectives (DQO) for site assessment investigations conducted by the HWP and ESP.

4.0 Field Activities

4.1 Sample Collection

Public and private well samples were collected from a point closest to the well head as possible. The tap was opened at a high flow for five minutes. After five minutes, specific conductivity, pH, and temperature readings were collected. The tap continued to run for an additional three minutes and field measurements were collected again. If all the parameters were considered stable, (pH within 0.2 units, temperature and specific conductivity within +/- 10%) a sample was collected. If water quality parameters were not within stable range then the tap continued to operate for an additional three minutes and this would be repeated until stabilization occurred. Groundwater samples collected for dissolved metals analysis were filtered in the field prior to submission to the laboratory. Each property was given a unique location identification number. Each sample was also given a unique sample number; both numbers were recorded on chain of custody forms and the samples were stored on ice in coolers until submission to the laboratory for analysis.

Locational data was collected at each wellhead using a Trimble GeoExplorer handheld global positioning system (GPS) and a minimum logging time of 60 seconds.

4.2 Analysis Requested

The samples submitted to the department's laboratory for the 10/2/17 sampling event were analyzed for volatile organic contaminants using method 524.2 and for total and dissolved metals (As, Ba, Cd, Cr, Cu, Se, Pb, Zn) using method 200.8. Due to matrix interferences that were discovered on the dissolved chromium and zinc analysis (see section 7.0 Observations), the samples were reanalyzed for chromium (a contaminant of concern) only on 10/27/17 using method 200.7.

As a result of the unusual dissolved chromium results from the 10/2/17 event, all of the sample locations were resampled on 10/19/17. These samples were analyzed for total and dissolved metals (Cr, Zn) only, using methods 200.8 and 200.7 for dissolved Cr. Also one of the original sample locations (Loc. ID 106) was analyzed for hexavalent chromium because the total Cr result from 10/2/17 was above 3.5 ug/L. The two new (background) locations were analyzed for total and dissolved metals (As, Ba, Cd, Cr, Cu, Se, Pb, Zn) and hexavalent chromium.

The samples submitted for the 2/13/18 sampling event were analyzed for total metals (Pb) only.

4.3 Number of Samples Collected

Refer to the tables below for sample information. Due to reasons explained below in the observation section, three sampling events took place for this site. During the first sampling event, twelve samples were collected. Fifteen samples were collected during the second sampling event. Four samples were collected for the third sampling event.

4.4 Chain-of-Custody

All samples were entered onto an ESP Chain of Custody (COC) form to be relinquished to a sample custodian at the department's Environmental Laboratory for analysis.

5.0 Quality Control (QC)

5.1 Field Decontamination

Clean disposable latex gloves were worn by sampling personnel and clean equipment was utilized for each sample location to minimize the possibility of cross-contamination.

5.2 Quality Assurance/Quality Control (QA/QC) Samples

The following samples were collected as part of the quality control/quality assurance procedures for the investigation.

5.2.1 Duplicate Groundwater Sample

One duplicate groundwater sample was collected during each of the first two sampling events only. The third sampling event did not have a duplicate sample collected. The duplicate sample was collected alongside its true sample using the same technique as for the true sample. The duplicate sample was assigned a unique sample number, was entered onto the chain-of-custody form as “blind duplicate”, and was submitted for the same analytes as its true sample.

5.2.3 Trip Blank

One trip blank sample consisting of analyte-free water was prepared in the laboratory, taken to the field, and accompanied samples collected and transported back to the laboratory. The trip blank received a numbered label, was entered onto the chain-of-custody form, and submitted for volatile organics analyses. The trip blank sample was only utilized during the 10/2/17 sampling event. VOCs analysis was not part of the 10/19/17 or the 2/13/18 sampling events.

5.2.4 Filter Blank

One filter blank sample was collected during the second sampling event. Analyte-free water was prepared in the laboratory, taken to the field, and pumped through a 0.45 micron groundwater filter typically used for collecting groundwater samples for dissolved metals analysis. 500ml-1000ml of the analyte free water was passed through the filter before the sample was collected. The filter blank sample received a number label, was entered on the chain-of-custody form, and submitted for dissolved metals analysis.

6.0 Investigation Derived Wastes (IDW) Plan

IDW generated during private drinking well evacuation was allowed to drain onto the ground. Disposable personal protective equipment and disposable sampling equipment were generally handled as solid waste, containerized, and properly disposed.

7.0 Observations

Site work began on 10/2/17. This sampling event was conducted in conjunction with the Dawson Metal Products Camdenton Facility #2 sampling event. The sampling team for this site consisted of Sean Counihan (ESP) and Keith Brown the HWP project manager. The sampling team began site work around 0815. Sampling went well. No anomalies were experienced during sampling and sampling was completed around 1400 hours. The samples were submitted to the ESP sample receiving for analysis.

Once the analytical results were complete, an issue arose when it was observed that the results for dissolved chromium were higher than what was reported in total chromium. All aspects of sampling were questioned (procedure, equipment used) and the results could not be duplicated in the lab.

As a result, it was decided to resample all of the drinking water wells sampled on 10/2/17 with some changes. Two additional properties were selected, away from the area of influence of the site, to be used as background samples. Additionally, one property that was sampled originally had lead levels that were elevated. Aside from the resample from the outside spigot, a new sample was collected from inside the home to gauge actual exposure after the water is run through a water softener treatment system that is in the home. Also, an additional container (for all samples) was collected and held for possible hexavalent chromium analysis. Location IDs 106, 118, and 123 were selected for the hexavalent chromium analysis.

The new sampling event was conducted on 10/19/17 by Ken Hannon and Eric Sappington with ESP and Keith Brown with HWP. No issues with sampling occurred. They began around 0800 hours and sampling was completed around 1600 hours. These samples were submitted to the lab on 10/20/17.

Preliminary results of these new samples again showed higher amounts of dissolved chromium over total chromium. The CAS laboratory staff began investigating the analytical method and analytical equipment used. It was discovered (a detailed explanation is below in appendix B) that a matrix interference occurred when using EPA method 200.8 for chromium resulting in a false positive.

The original samples collected on 10/2/17 were reanalyzed for chromium only, using EPA method 200.7. The new set of samples collected on 10/19/17 was also analyzed using method 200.7

The analytical results from one of the background locations (a new location) chosen for the 10/19/17 sampling event (Location ID 123) showed unexpected elevated lead levels. On 2/13/18 this location was resampled to verify the results of the original sample. A sample was again collected from the outside tap, along with samples from the kitchen sink, from the filtered refrigerator water dispenser, and from a Brita water filtration pitcher system. The home itself does not have a filtration/water softening system. The refrigerator sample had 1000 milliliters of water purged from the system to get fresh water in the line. The Brita sample was collected directly from the pitcher.

8.0 Data Reporting

Please refer to Appendix B for analytical results of samples collected. The original 10/2/17 results are reported as an addendum showing the false positive and the new EPA method 200.7 result. The results of the resampling effort on 10/19/17 and 2/13/18 follow the original results.

SIGNATURES

Prepared by:

Sean Counihan
Environmental Specialist
Field Services Unit
Environmental Services Program

Approved by:

APPROVED
By Eric Sappington at 9:31 am, Apr 19, 2018

Eric J. Sappington
Unit Chief
Field Services Unit
Environmental Services Program

ES:smc

c: Keith Brown, HWP